AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

(Approved by A.I.C.T.E., New Delhi &Permanently Affiliated to JNTU-GV, Vizianagaram)
NAAC Accredited with A+ grade
Tamaram (V), Makavarapalem, Narsipatnam (RD), Anakapalle Dist,Pin-531113

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC REGULATIONS

COURSE STRUCTURE AND SYLLABUS

For UG-R24

B.Tech – MECHANICAL ENGINEERING

(Applicable for batches admitted from 2024-2025)

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Academic Regulations 2024 (R24) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the
Academic Year: 2024-2025 onwards)

1. Award of the B.Tech Degree

(a) Award of the B.Tech. Degree/ B.Tech. Degree with a Minor: If he/ she fulfils the following:

(i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would be in addition to the maximum period permitted for graduation (Eight Years).

(ii) Registers for 160 credits and secures all 160 credits.

(b) Award of B.Tech. Degree with Honors: If he / she fulfils the following:

(i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. Program i.e., 160 credits.

(ii) Registering for Honors is optional.

(iii) Honors are to be completed simultaneously with B.Tech. Programme.

2. Students, who fail to fulfill all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. Course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

3. Courses of study:

The following courses of study are offered at present with specialization in the B.Tech

S.No.	Branch Code - Abbreviation	Branch
1.	02-EEE	Electrical and Electronics Engineering
2.	03-ME	Mechanical Engineering
3.	04-ECE	Electronics and Communication Engineering
4.	05-CSE	Computer Science and Engineering
5.	42-CSM	Computer Science and Engineering (Artificial Intelligence and Machine Learning)

6.	44-CSD	Computer Science and Engineering (Data Science)

4. Admissions

Admission to the B. Tech Program shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/ Institution from time to time. Admissions shall be made either based on the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government /Institution or to any other order of merit approved by the A.P. Government / Institution, subject to reservations as prescribed by the Government/ Institution from time to time.

5. Program related terms

Credit: A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit Definition:

1Hr. Lecture (L) per week	1 Credit
1Hr.Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hr. Practical (Lab) per week	1 Credit

a) **Semester:** A semester comprises 90 working days.

b) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.

c) **Choice Based Credit System (CBCS):** The CBCS provides a choice for students to select from the prescribed courses.

6. Semester / Credits:

i) A semester comprises 90 working days and an academic year is divided into two semesters.

ii) The summer term is for eight weeks during summer vacation. Internship / apprenticeship / work-based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.

iii) Regular courses may also be completed well in advance through MOOCs satisfying prerequisites.

7. Structure of Undergraduate Programme

All courses offered for the undergraduate program (B. Tech.) are broadly classified as follows:

S.No.	Category	Breakup of Credits (Total 160)	Percentage of total credits	AICTE Recommendation(%)
1.	Humanities and Social Science including Management (HM)	13	8 %	8 – 9%
2.	Basic Sciences (BS)	20	13 %	12 - 16%
3.	Engineering Sciences (ES)	23.5	14%	10 – 18%
4.	Professional Core (PC)	54.5	34 %	30 – 36%
5.	Electives – Professional (PE) & Open (OE); Domain Specific Skill Enhancement Courses (SEC)	33	21 %	19 - 23%
6.	Internships & Project work (PR)	16	10 %	8 – 11%
7.	Mandatory Courses (MC)	Non-credit	Non-credit	-

8. Course Classification:

All subjects/ courses offered for the undergraduate programme in Engineering (B.Tech. Degree programmes) are broadly classified as follows:

S. No.	Broad Course Classification	Course Category	Description
1.	Foundation Core Courses	Foundation courses	Includes Mathematics, Physics and Chemistry; fundamental engineering courses; Humanities, Social sciences and Management courses
2.	Professional Core Courses	Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
3.	Open Elective Courses	Professional Elective Courses (PE)	Include selective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include interdisciplinary Subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering
		Domains Specific Skill Enhancement Courses (SEC)	Interdisciplinary/ job-oriented / domain courses which are relevant to the industry
4.	Project Internships	Project	B.Tech. Project (or) Major Project
		Internships	Summer Internships–Community based and Industry Internships; Industry oriented Full Semester Internship
5.	Audit Courses	Mandatory non-credit courses	Covering subjects of developing desired attitude among the learners

9. Programme Pattern

i. Total duration of the B.Tech (Regular) Programme is four academic years.

ii. Each academic year of study is divided into two semesters.

iii. Minimum number of instruction days in each semester is 90 days

iv. There shall be mandatory student induction program for fresher's, with three- week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept. /Branch & Innovations etc., are included as per the guidelines issued by AICTE.

v. Health/wellness/yoga/sports and NCC / NSS / Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students

vi. Courses like Environmental Sciences, Indian Constitution, and Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.

vii. Design Thinking for Innovation & Tinkering Labs is made mandatory as credit courses for all the undergraduate students.

viii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

ix. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in emerging areas within the chosen field of study.

x. A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for B.Tech. Degree with a Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.

xi. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.

xii. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.

xiii. Students shall undergo mandatory summer internships, for a minimum of eight weeks duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year

xiv. There shall also be mandatory full internship in the final semester of the programme along with the project work.

xv. Undergraduate degree with Honors is introduced by the Institution for the students having good academic record.

xvi. Each college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

xvii. Each college shall assign a faculty advisor/ mentor after admission to a group of students from same department to provide guidance in courses registration/ career growth/ placements/ opportunities for higher studies/ GATE/ other competitive exams etc.

xviii. Preferably 25% of course work for the theory courses in every semester shall be conducted in the blended mode of learning.

10. Evaluation Process

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical subject. Summer Internships shall be evaluated for 50 marks, Full Internship & Project work in final semester shall be evaluated for 200 marks, and mandatory courses with no credits shall be evaluated for 30 MID semester marks.

A student has to secure not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester and end examination marks taken together for the theory, practical, design, drawing subject or project etc. In case of a mandatory course, he / she should secure 40% of the total marks.

Theory Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	100

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.

ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.

iii) If any course contains two different branch subjects, the syllabus shall be written in two parts with 2.5 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.

iv) If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of “T for theory subject and P for practical” subject.

a) Continuous Internal Evaluation

i) For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective questions / short answer questions (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.

ii) Objective paper shall contain for 05 short answer questions with 2 marks each or maximum of 20 bits / multiple choice questions (MCQ's) for 10 marks. Subjective paper shall contain 3 questions and each question carries 10 marks. The marks obtained in the subjective paper are condensed to 15 marks.

Note:

- The objective paper shall be prepared in line with the quality of competitive examinations questions.
- The subjective paper shall contain 3 questions of equal weightage of 10 marks. Any fraction shall be rounded off to the next higher mark.
- The objective paper shall be conducted either online or offline by the respective department on the day of subjective paper test.
- Assignments shall be in the form of problems, mini projects, design problems, slip tests, quizzes etc., depending on the course content. It should be continuous assessment throughout the semester and the average marks shall be considered.

iii) If the student is absent for the mid semester examination, no re-exam shall be conducted and mid semester marks for that examination shall be considered as zero.

iv) First midterm examination shall be conducted for 2.5 (I Unit, II Unit and III Unit half part) units of syllabus the second midterm examination shall be conducted for remaining 2.5 Units (III Unit half part, IV and V units).

v) Final mid semester marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage given to the better mid exam and 20% to the other.

For Example:

- Marks obtained in first mid: 25
- Marks obtained in second mid: 20
- Final mid semester Marks: (25 x 0.8) + (20 x 0.2) = 24

If the student is absent for any one midterm examination, the final mid semester marks shall be arrived at by considering 80% weightage to the marks secured by the student in the appeared examination and zero to the other. For Example:

- Marks obtained in first mid: Absent

- Marks obtained in second mid: 25
- Final mid semester Marks: (25 x 0.8) + (0 x 0.2) = 20

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern:

(i) There shall be 6 questions and all questions are compulsory.

(ii) Question I shall contain 10 compulsory short answer questions for a total of 20 marks such that each question carries 2 marks. There shall be 2 short answer questions from each unit

(iii) In each of the questions from 2 to 6, there shall be either / or type questions of 10 marks each and each question have internal choice. Student shall answer any one of them.

(iv) The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question.

End examination of theory subjects consisting of two parts of different subjects, for Example: Basic Electrical & Electronics Engineering shall have the following pattern:

(i) Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.

(ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1mark.

(iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.

(iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

Practical Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

a) For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.

b) Day-to-Day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the regularity / record / viva and 15 marks for the internal test.

c) The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same department.

- Procedure:20 marks
- Experimental work & Results: 30 marks
- Viva Voce: 20 marks.

In a practical subject consisting of two parts (Eg: Basic Electrical & Electronics Engineering Lab), the examination shall be conducted for 70 marks as a single laboratory in 3 hours. Mid semester examination shall be evaluated 30 marks in each part. Mid semester examination shall be evaluated as above for 30 marks in each part and final mid semester marks shall be arrived by considering the average of marks obtained in two parts.

d) For the subject having design and/or drawing, such as Engineering Drawing, the distribution of marks shall be 30 for mid semester evaluation and 70 for end examination.

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

Day-to-Day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weightage of 80% to better mid marks and 20% for the other. The subjective paper shall contain 3 either or type questions of equal weightage of 5 marks. There shall be no objective paper in mid semester examination. The sum of day-to-day evaluation and the mid semester marks will be the final sessional marks for the subject.

The end examination pattern for Engineering Graphics, shall consists of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination.

e) There shall be no external examination for mandatory courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a re-examination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.

f) The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

11. Skill oriented Courses

i) There shall be five skill-oriented courses offered during III to VII semesters.

ii) Out of the five skill courses, two shall be skill-oriented courses from the same domain of their main three skill courses, one shall be a soft skill course and the remaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.

iii) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-Day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/ assignments / viva/ mid semester test. The end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the subject nominated by the principal.

iv) The Head of the Department shall identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The marks / grades shall be assigned to the students by the above committee based on their performance.

v) The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency. A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.

vi) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the Institute.

12. Massive Open Online Courses (MOOCs):

A Student has to pursue and complete one course compulsorily through MOOCs approved by the Institute. A student can pursue courses other than core through MOOCs and it is mandatory to complete one course successfully through MOOCs for awarding the degree. A student is not permitted to register and pursue core courses through MOOCs.

A student shall register for the course (Minimum of either 8 weeks or 12 weeks) offered through MOOCs with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the student's progression. The student needs to earn a certificate by passing the exam. The student shall be awarded the credits assigned in the curriculum only by submission of the certificate. Examination fee, if any, will be borne by the student.

Students who have qualified in the proctored examinations conducted through MOOCs platform can apply for credit transfer as specified and are exempted from appearing internal as well as external examination (for the specified equivalent credit course only) conducted by the Institute.

Necessary amendments in rules and regulations regarding adoption of MOOC courses would be proposed from time to time.

13. Credit Transfer Policy

Adoption of MOOCs is mandatory, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the Institution shall allow up to a maximum of 20% of the total courses being offered in a particular programme i.e., maximum of 32 credits through MOOCs platform.

i) The AIET (A) shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses.

ii) Student registration for the MOOCs shall be only through the respective department of the institution, it is mandatory for the student to share necessary information with the department.

iii) The Credit transfer policy will be applicable to the Professional & Open Elective courses only.

iv) The concerned department shall identify the courses permitted for credit transfer.

v) The Institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.

vi) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

vii) The Institute shall ensure no overlap of MOOC exams with that of the Institute examination schedule. In case of delay in results, the Institute will re-issue the marks sheet for such students.

viii) Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

ix) The institution shall submit the following to the examination section of the Institute:

(a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.

(b) Undertaking form filled by the students for credit transfer.

x) The Institution` shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall be permitted to register for MOOCs offered through online platforms approved by the Institute from time to time.

14. Academic Bank of Credits (ABC)

The Institute has implemented Academic Bank of Credits (ABC) to promote flexibility in curriculum as per NEP 2020 to

i) Provide option of mobility for learners across the universities of their choice.
ii) Provide option to gain the credits through MOOCs from approved digital platforms.
iii) Facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
iv) Execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students account.

15. Mandatory Internships

Summer Internships: Two summer internships either onsite or virtual each with a minimum of 08 weeks duration, done at the end of second and third years, respectively are mandatory. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the Undergraduate program. One of the two summer internships at the end of second year (Community Service Project) shall be society oriented and shall be completed in collaboration with government organizations/ NGOs & others. The other internship at the end of third year is Industry Internship and shall be completed in collaboration with Industries. The student shall register for the internship as per course structure after commencement of academic year. The guidelines issued by the APSCHE / Institute shall be followed for carrying out and evaluation of Community Service Project and Industry Internship.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, supervisor of the internship and as senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. The report and the oral presentation shall carry 50% weightage each. It shall be evaluated for 50 external marks. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the Institute.

Full Semester Internship and Project work:

In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner. The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be show cased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the Institute and is evaluated for 140 marks.

The institute shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

16. Guidelines for offering Minor

To promote inter disciplinary knowledge among the students; the students admitted into B.Tech.in a major stream / branch are eligible to obtain degree in Minor in another stream.

i) The Minor program requires the completion of 12 credits in Minor stream chosen.

ii) Two courses for 06 credits related to a Minor are to be pursued compulsorily for them in or degree, but may be waived for students who have done similar / equivalent courses. If waived for a student, then the student must take an extra elective course in its place. It is recommended that students should complete the compulsory courses (or equivalents) before registering for the electives.

iii) Electives (minimum of 2 courses) to complete a total of 12 credits.

Note: A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.

17. Guidelines for offering Honors

The objective of introducing B.Tech. (Honors) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors are introduced in the curriculum of all B.Tech. Programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering.

ii) A student shall earn additional 15 credits for award of B.Tech. (Honors) degree from same branch/ department/ discipline registered for major degree. This is in addition to the credits essential for obtaining the under graduate degree in Major Discipline (i.e., 160 credits).

iii) A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.

iv) The concerned head of the department shall arrange separate class work and timetable of the courses offered under Honors program.

v) Courses that are used to fulfill the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.

vi) Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.

vii) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.

viii) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.

ix) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree programme.

x) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xi) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering.

Enrolment into Honors:

i) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline

ii) The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to III semester incase of regular entry students and only III semester in case of lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.

iii) If a student is detained due to lack of attendance either in Major or in Honors, registration shall be cancelled.

iv) Transfer of credits from Honors to regular B.Tech degree and vice-versa shall not be permitted.

v) Honors are to be completed simultaneously with a Major degree program.

Registration for Honors:

i) The eligible and interested students shall apply through the HOD of his / her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honors.

ii) The selected students shall submit their willingness to the principal through his/her parent department offering Honors. The parent department shall maintain the record of student pursuing the Honors.

iii) The students enrolled in the Honors courses will be monitored continuously. An advisor/ mentor from parent department shall be assigned to a group of students to monitor the progress.

iv) There is no fee for registration of subjects for Honors program offered in offline at the respective institutions.

18. Attendance Requirements:

i) A student shall be eligible to appear for the Institution's / Institute's external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College's Academic Committee.

ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.

iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the Institute.

iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

v) A student will not be promoted to the next semester unless he/she satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.

vi) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

viii) For induction programme attendance shall be maintained as per AICTE norms.

19. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 18.

i) A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per college norms.

ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any **decimal** fraction should be **rounded off** to **lower** digit) up to in the subjects that have been studied up to III semester.

iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any **decimal** fraction should be **rounded off** to **lower** digit) in the subjects that have been studied up to V semester. And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.

iv) When a student is detained due to lack of credits/ shortage of attendance he/she may be re-admitted when the semester is offered after fulfillment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

20. Grading:

As measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed: **A**fter each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	Grade	Grade points Assigned
90 & above	S (Superior)	10
80 - 89	A (Excellent)	9
70 - 79	B (Very Good)	8

60 - 69	C (Good)	7
50 -59	D (Average)	6
40-49	E (Pass)	5
<40	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade “F” or Grade “Ab“ in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For non-credit audit courses, “Satisfactory” or “Unsatisfactory” shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/ Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

SGPA: The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses under gone by a student, i.e.,

$$\mathbf{SGPA = \Sigma\ (C_i \times G_i)\ /\ \Sigma\ C_i}$$

Where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

CGPA: The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses under gone by a student over all the semesters of a program, i.e.

$$\mathbf{CGPA = \Sigma\ (C_i \times S_i)\ /\ \Sigma C_i}$$

Where “S_i” is the SGPA of the i^{th} semester and C_i is the total number of credits up to that semester.

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. While computing the SGPA the subjects in whom the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters S, A, B, C, D, E and F.

Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and are eligible for the award of B.Tech. Degree, he/she shall be placed in one of the following four classes:

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.5 (Without any supplementary appearance)
First Class	$\geq 6.5 < 7.5$
Second Class	$\geq 5.5 < 6.5$
Pass Class	$\geq 5.0 < 5.5$

Note: Students who have written supplementary examinations to fulfill the credit requirement will not be awarded First Class with Distinction. For such students the highest degree that is awarded will be First Class Only.

CGPA to Percentage conversion Formula: (CGPA–0.75) x 10

21. With-holding of Results

If the candidate has any dues not paid to the Institute or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be with held in such cases.

22. Multiple Entry/ Exit Option

(a) Exit Policy:

The students can choose to exit the four-year programme at the end of First / Second/ Third year.

i) **UG Certificate (in Field of study/ discipline)** - Programme duration: First year (first two semesters) of the undergraduate programme, 40 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6- credit job-specific internship / apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

ii) **UG Diploma (in Field of study/ discipline)** – Programme duration: First two years (first four semesters) of the undergraduate programme, 80 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6- credit job-specific internship / apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

iii) **Bachelor of Science (in Field of study/discipline)** i.e., **B.Sc. Engineering in (Field of study/discipline)** - Programme duration: First three years (first six semesters) of the undergraduate programme, 120 credits.

(b) Entry Policy:

Modalities on multiple entry by the student into the B.Tech. Programme will be provided in due course of time.

Note: The Institute shall resolve any issues that may arise in the implementation of Multiple Entry and Exit policies from time to time and shall review the policies in the light of periodic changes brought by UGC, AICTE/APSCHE and State government.

23. Gap Year Concept:

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/ to establish startups. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The principal of the respective college shall forward such proposals submitted by the students to the Institute. An evaluation committee constituted by the Institute shall evaluate the proposal submitted by the student and the committee shall decide whether to permit the student(s) to avail the Gap Year or not.

24. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfillment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subjected to Section 2 and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, subjected to Section **2** and they will follow the academic regulations in to which they are readmitted.

25. Minimum Instruction Days for a Semester:

The minimum instruction days including internal exams for each semester shall be 90 days.

26. Medium of Instruction:

The medium of instruction of the entire B.Tech undergraduate programme in Engineering (including examinations and project reports) will be in English only.

27. Student Transfers:

Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh / JNTU-

GV and the Institute from time to time.

28. General Instructions:

i) The academic regulations should be read as a whole for purpose of any interpretation.

ii) Malpractices rules-nature and punishments are appended.

iii) Where the words “he”, “him”, “his”, occur in the regulations, they also include “she”, “her”, “hers”, respectively.

iv) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal / Dean-Academics of the institution is final.

v) The Institute may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Institute.

vi) In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Principal / Dean-Academics of the institution is final.

ACADEMIC REGULATIONS (R24) for
B.Tech (LATERAL ENTRY SCHEME)

(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year **2025-2026** onwards)

1. Award of the Degree

(a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfills the following:

(i) Pursues a course of study for not less than three academic years and not more than six academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Six years).

(ii) Registers for 120 credits and secures all 120 credits.

(b) **Award of B.Tech. Degree with Honors**

A student will be declared eligible for the award of the B.Tech. with Honors if he / she fulfils the following:

i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. Program i.e., 120 credits.

ii) Registering for Honors is optional.

iii) Honors are to be completed simultaneously with B.Tech programme.

2. Students, who fail to fulfill the requirement for the award of the degree within six consecutive academic years from the year of admission, shall forfeit their seat.

3. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.**2**

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.

ii. A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any decimal fraction should be rounded off to lower digit) in the subjects that have been studied up to V semester.

And in case if student is already detained for want of credits for particular academic year, the student may make up the credits through supplementary exams of the above exams before the commencement of IV year I semester class work of next year.

4. Course Pattern

i) The entire course of study is three academic years on semester pattern.

ii) A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii) When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfillment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

5. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

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(Dr. R Prasad Rao)
Dean(Academics) &
Member Secretary (AC)

(Dr.C P V N J Mohan Rao)
Chairman
Academic Council

AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)
(Approved by A.I.C.T.E., New Delhi &Permanently Affiliated to JNTU-GV, Vizianagaram)
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DEPARTMENT OF MECHANICAL ENGINEERING

Proposed Course Structure

Programme – B.Tech-Mechanical Engineering (R24)

Regulation- R24

(Applicable for the academic year 2024-25 to 2026-27)

Induction Programme

S.No	Course Title	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools andplatforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading,Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech- Mechanical Engineering **Regulation**- R24

I Year I Semester- Course Structure

S. No.	Categ ory	Course Code	Course Name	Hours per Week			
				L	T	P	Credits
1.	BS	R24BS01	Linear Algebra & Calculus	3	0	0	3
2.	BS	R24BS07	Engineering Chemistry	3	0	0	3
3.	ES	R24ES02	Problem solving and programming with C	3	0	0	3
4.	ES	R24ES06	Engineering Graphics	1	0	4	3
5.	ES	R24ES05	Basic Electrical & Electronics Engineering	3	0	0	3
6.	BS	R24BS08	Engineering Chemistry Lab	0	0	2	1
7.	ES	R24ES03	Problem solving and programming with C Lab	0	0	3	1.5
8.	ES	R24ES07	Basic Electrical & Electronic Engineering Lab	0	0	3	1.5
9.	ES	R24ES08	Engineering Workshop	0	0	3	1.5
10.	MC	R24MC01	Health and Wellness, Yoga and Sports	0	0	1	0.5
			Total	**13**	**0**	**16**	**21**

Category	Courses	Credits
BS- Basic Sciences Course	3	7
ES- Engineering Science Courses	6	13.5
MC- Mandatory Course	1	0.5
Total	**10**	**21**

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech- Mechanical Engineering **Regulation**- R24

I Year II Semester- Course Structure

S. No.	Category	Course Code	Course Name	Hours per Week			
				L	**T**	**P**	**Credits**
1.	BS	R24BS04	Differential Equations and Vector Calculus	3	0	0	3
2.	BS	R24BS02	Engineering Physics	3	0	0	3
3.	HS	R24HS01	Communicative English	2	0	0	2
4.	ES	R24ES01	Basic Civil & Mechanical Engineering	3	0	0	3
5.	PC	R24MEPC01	Engineering Mechanics	3	0	0	3
6.	HS	R24HS02	Communicative English Lab	0	0	2	1
7.	BS	R24BS03	Engineering Physics Lab	0	0	2	1
8.	ES	R24ES04	IT workshop	0	0	2	1
9.	PC	R24MEPC02	Engineering Mechanics Lab	0	0	3	1.5
10.	MC	R24MC02	NSS/NCC/Scouts & Guides/ Community Service	0	0	1	0.5
			Total	**14**	**0**	**10**	**19**

Category	Courses	Credits
BS- Basic Sciences Course	3	7
PC- Professional Core Courses	2	4.5
HM- Humanities and Social Scienceincluding Management	2	3
ES- Engineering Sciences	2	4
MC- Mandatory Course	1	0.5
Total	**10**	**19**

Linear Algebra and Calculus

I B.TECH- I SEMESTER (Common to all Branches)

Course Title: Linear Algebra and Calculus	Course Code: R24BS01
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods: 3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Linear algebra is a prerequisite for calculus, and that you should have a deep understanding of linear algebra before moving on to calculus.	

COURSE OVERVIEW:

- A course on linear algebra and calculus typically covers fundamental concepts like vectors, matrices, linear systems, differentiation, and integration.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To equip the students with standard concepts and tools of mathematics to handle various real-world problems and their applications.
2. To enable the students to apply linear algebra to solve engineering problems.
3. To enable the students to apply calculus to solve engineering problems.
4.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Develop matrix algebra techniques that are needed by engineers for practical applications.
CO2	To find the eigen values and eigen vectors and solve the problems by using linear transformation.
CO3	Apply the knowledge of mean value theorems, solve inequality.
CO4	Familiarize with functions of several variables which is useful in optimization.
CO5	Familiarize with double and triple integrals of functions of several variables in two and three dimensions.

COURSE CONTENT (SYLLABUS)

UNIT-I: Matrices and Linear System of Equations

Matrices: Vector Space, Linear independent, dependent (only definitions).

Rank of a matrix by echelon form, normal form. Cauchy-Binet formulae (without proof). Inverse of Non- singular matrices by Gauss- Jordan method.

System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method.

Self-Learning Topic: Encoding and Decoding messages by using matrices

UNIT- II: Linear Transformation and Orthogonal Transformation

Eigen values and Eigen vectors and their properties(without proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley–Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

Self-Learning Topic: Google's page rank Algorithm.

UNIT–III: Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), problems on the above theorems.

Self-Learning Topic: Application of mean value theorems

UNIT- IV: Partial differentiation and Applications

Partial derivatives, total derivatives, chain rule, change of variables, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobian, maxima and minima of functions of two variables, method of Lagrange multipliers.

Self-Learning Topic: Jacobian of implicit functions.

UNIT-V: Multiple Integrals

Double integrals - change of variables (Cartesian and Polar coordinates), change of order of integration, Cylindrical and Spherical coordinates, triple integrals. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).
Self-Learning topic: Calculating Centers of Mass and Moment of inertia

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

Reference Books:

1. Dennis G. Zill and Warren S. Wright , Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2. Michael Green berg, Advanced Engineering Mathematics, 9th edition, Pearson edn.
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science
5. International Ltd., 2021 (9th reprint).
6. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017.

Web References:

1. http://onlinecourses.nptel.ac.in
2. https://nptel.ac.in/courses/111105121
3. https://onlinecourses.nptel.ac.in/noc24_ma91/course
4. https://onlinecourses.nptel.ac.in/noc24_ma53/course
5. https://onlinecourses.nptel.ac.in/noc24_ma11/course

ENGINEERING CHEMISTRY
I B.TECH-I SEMESTER

Course Title: Engineering Chemistry	Course Code: R24BS07
Teaching Scheme(L:T:P): 3:0:0	Credits:3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30Marks	Semester End Exam: 70Marks
Prerequisites: Basic Chemistry, Environmental Science, Materials	

COURSE OVERVIEW:

- An Engineering chemistry course applies chemical principles to analyze and evaluate engineering problems.

COURSE OBJECTIVES:

The objectives of this course are to

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement
- To impart basic concepts of fuels
- To introduce Refractories

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Assessment of the quality of Water Specifications for drinking water
CO2	Demonstrate the corrosion prevention methods and factors affecting corrosion
CO3	Explain the Preparation, Properties and applications of thermo plastics & thermo setting plastics, Explain calorific values, octane number, refining of petroleum and cracking of oils.
CO4	Explain the setting and hardening of cement.
CO5	Summarize the concepts of colloids, micelle and nanomaterials

COURSE CONTENT(SYLLABUS)

UNIT –I Water Technology

Soft and hard water, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen – Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment–Specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, Ion-exchange processes – desalination of brackish water, reverse osmosis (RO) and electro dialysis.

Self Learning Topics : Parameters of drinking water

UNIT-II Electro chemistry and Applications

Electrodes–electrochemical cell, Nernst equation, cell potential calculations.
Primary cells – Zinc-air battery, Secondary cells –Nickel-Cadmium (NiCad),and lithium ion batteries-working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.
Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).
Self Learning Topics: Pb-Acid battery, Methods of Coatings for Controlling Corrosion.

UNIT-III Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.
Elastomers–Preparation, properties and applications of Buna S Buna N and Thiokol rubbers
Fuels **–** Types of fuels, calorific value of fuels, numerical problems based on calorific value;
Analysis of coal (Proximate and Ultimate analysis),Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol. and bio fuel-bio diesel.
Self Learning Topics: Differences between Thermoplastics and Thermo-setting plastics, Gaseous Fuels

UNIT-IV Modern Engineering Materials

Composites- Definition, Constituents, Classification- Particle, Fiber and Structural reinforced composites, properties and Engineering applications
Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.
Lubricants-Classification, Functions of lubricants, Mechanism, Properties of lubricating oils Flash point, Fire point, Cloud point, and Applications
Self Learning Topics : Carbon Rein Forced Plastics, Applications of Lubricants.

UNIT-V Surface Chemistry and Nanomaterials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical methods of preparation of nanometals and metal oxides, adsorption isotherm (Freundlich and Longmuir) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Self Learning Topics : Characterization of Nano Materials

Textbooks:

1. Jain and Jain, Engineering Chemistry,16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio dePaula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications,1997.
2. D.J.Shaw, Introduction to Colloidsand Surface Chemistry, Butterworth – Heineman,1992.
3. Text book of Polymer Science, FredW.BillmayerJr,3rdEdition

Web References:

1. https://swayam.gov.in/nc_details/NPTEL
https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-cy50

Problem Solving & Programming with C

I B.TECH- I SEMESTER (Common to all Branches)

Course Title: Problem Solving & Programming with C	Course Code: R24ES07
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods: 3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: strong background in problem-solving skills and an understanding of data structures and algorithms.	

COURSE OVERVIEW:

1. To understand computer programming and its roles in problem solving.
2. To understand and develop well-structured programs using C language.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
2. To express algorithms and draw flowcharts in a language independent manner.
3. To enable effective usage of Operators &Control Structures.
4. To learn about the design concept of Arrays, Strings and Functions.
5. To understand Structures and Unions and their usage.
6. To assimilate about Pointers, Dynamic Memory Allocation and know the significance of Pre-processors, perform operations on files.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Illustrate the fundamental concepts of computers and basic computer programming and problem-solving approach.
CO2	Understand the Control structures, Branching and Looping.
CO3	Make use of Arrays and Develop Programs on modular programming using functions and strings.
CO4	Demonstrate the ability to write programs using Structures and Unions.
CO5	Apply File handling operations.

COURSE CONTENT (SYLLABUS)

UNIT-I: Introduction to Programming and Algorithm for Problem Solving:

Introduction to Programming: The Basic Model of Computation, Algorithms, Flow-charts, Programming Languages, Compilation, Linking and Loading, Testing and Debugging, Documentation,

Algorithm for Problem Solving: Exchanging values of two variables, summation of a set of numbers, Decimal Base to Binary Base conversion, Reversing digits of an integer, GCD (Greatest Common Division) of two numbers, Test whether a number is prime, Organize numbers in ascending order, Find square root of a number, factorial computation, Fibonacci sequence, Evaluate 'sin x' as sum of a series, Reverse order of elements of an array, Find largest number in an array, Print elements of upper triangular matrix, multiplication of two matrices, Evaluate a Polynomial.

Self-Learning Topics: Compilation and Interpretation

UNIT- II: Introduction to the 'C' Programming

Introduction: Character set, Variables and Identifiers, Built-in Data Types, Input/output statements, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Type Casting and Type def Simple 'C' programs. Storage Classes**:** Scope and extent, Storage Classes in a single source file: auto, extern and static, register, Storage Classes in multiple source files: extern and static.

Conditional Statements and Loops: Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, Break statement, Go to statement.

Self-Learning Topics: Escape Sequences

UNIT – III: Arrays

Arrays: One dimensional array: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; two dimensional arrays with examples.

Strings: Concepts, String Types, String Input / Output functions, String manipulation functions, Null terminated strings as array of characters,

Self-Learning Topics: String Pattern Matching

UNIT- IV: Functions &Pointers

Functions: Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, passing arguments to a Function: call by reference; call by value, Recursive Functions, arrays as function arguments, Standard library string functions.

Pointers: Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation.

Self-Learning Topics: How do you pass a structure to a function?

UNIT-V: Structures and Unions

Structures and Unions: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures, and arrays: arrays of structures, structures containing arrays, unions, Enumeration.

File Processing: Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input/output functions (standard library input/output functions for files), file status functions (error handling), Positioning functions

Self-Learning Topics: Binary Files and operations on Binary files

TEXT BOOKS:

1. Byron S Gottfried "Programming with C" Second edition, Tata McGrawhill, 2007 (Paperback)
2. R.G. Dromey, "How to solve it by Computer", Pearson Education, 2008.
3. Kanetkar Y, "Let us C", BPB Publications, 2007.
4. 4. Hanly J R & Koffman E.B, "Problem Solving and Program design in C", Pearson Education, 2009.

REFERENCE BOOKS:

1. E. Balaguruswamy, "Programming with ANSI-C", Fourth Edition,2008, Tata McGraw Hill.
2. Venugopal K. R and Prasad S. R, "Mastering 'C'", Third Edition, 2008, Tata McGraw Hill.
3. B.W. Kernighan & D. M. Ritchie, "The C Programming Language", Second Edition, 2001, Pearson Education
4. ISRD Group, "Programming and Problem-solving Using C", Tata McGraw Hill, 2008.
5. Pradip Dey, Manas Ghosh, "Programming in C", Oxford University Press, 2007.

Web References:

1. http://www.c4learn.com/
2. http://www.geeksforgeeks.org/c/
3. http://nptel.ac.in/courses/122104019/
4. https://www.tutorialspoint.com/c programming/
5. http://www.learn-c.org/

Engineering Graphics

I B.TECH- I SEMESTER (Common to All Branches)

Course Title: Engineering Graphics	Course Code: R24ES06
Teaching Scheme (L:T:P): 1:0:4	Credits: 3
Type of Course: Lecture + Practical	Total Contact Periods: 5
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Basic Geometry, Basic Mathematics, Computer Skills, Visualization Skills	

COURSE OVERVIEW:

- The Engineering Graphics and Drawing course provides essential skills in visualizing and representing three-dimensional objects on two-dimensional media. Through structured units, students learn fundamentals such as line work, lettering, dimensioning, and geometric construction. The syllabus includes constructing curves, understanding scales, and mastering orthographic and isometric projections, essential for accurately depicting objects in engineering design.
- Additionally, students gain experience with computer-aided drafting using AutoCAD, learning to create 2D and 3D drawings and perform basic transformations. This course provides a strong foundation for technical drawing, crucial for design, manufacturing, and communication in engineering.

COURSE OBJECTIVES:

The objectives of this course are to

1. Understand the fundamentals of engineering drawing, including lines, lettering, and dimensioning.
2. Develop skills in geometrical constructions, including regular polygons and curves.
3. Learn orthographic projection techniques, including projections of points, lines, and planes.
4. Understand how to project solids in simple positions and create sectional views.
5. Develop skills in converting isometric views to orthographic views and vice versa.
6. Apply computer-aided design (CAD) techniques using AutoCAD to create 2D and 3Ddrawings.
7. Understand the importance of reference planes and reference lines in orthographic projection.
8. Develop problem-solving skills in engineering drawing, including creating and interpreting drawings.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the basics of Engineering Graphics to construct the polygon, curves, and scales.
CO2	Draw the orthographic projections of points and straight lines inclined to both the planes.
CO3	Draw the projections of planes in various conditions.
CO4	Draw the projections of regular solids, with its axis inclined to one plane and sections of solids.
CO5	Visualize the 3D isometric views from 2Dorthographic views and vice versa along with basic introduction to CAD.

COURSE CONTENT (SYLLABUS)

UNIT -I:

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general method.

Curves: construction of ellipse, parabola, and hyperbola by general method, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

UNIT-II:

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections oa point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

UNIT-III:

Projections of Planes: Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT-IV:

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of sections for simple position only.

UNIT-V:

Conversion of Views: Conversion of isometric views to orthographic views and Conversion of orthographic views to isometric views for simple objects only.

Computer graphics: Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (Not for end examination).

TEXT BOOKS:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House.

REFERENCE BOOKS:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc.
3. Engineering Drawing with an Introduction to AutoCAD, DhananjayJolhe, Tata McGraw Hill.

ONLINE RESOURCES:

1. https://www.iitg.ac.in/rkbc/me111.htm
2. https://archive.nptel.ac.in/courses/112/105/112105294/

E-BOOKS:

1. https://www.pdfdrive.com/textbook-of-engineering-drawing-e28918244.html

Basic Electrical and Electronics Engineering

I B.TECH- I SEMESTER (Common to ECE, EEE & MECH)

Course Title: Basic Electrical and Electronics Engineering	Course Code: R24ES05
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods: 3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Solid state physics, Linear algebra, calculus.	

COURSE OVERVIEW:

- This course introduces to the concepts and definitions of Ohms law, KCL, KVL, power and energy. By applying Kirchhoff's current and voltage laws to circuits in order to determine voltage, current and power in branches of any circuits excited by DC voltages and current sources. Apply simplifying techniques to solve DC circuit problems using basic circuit theorems and structured methods like node voltage and mesh current analysis. This course also introduces the construction and operating principle of AC machines, DC machines, Generators and Transformers.
- This course explores the evolution of electronics, characteristics of PN junction and Zener diodes, and bipolar junction transistors in various configurations. It includes rectifiers, power supplies, and amplifiers, focusing on circuit diagrams and frequency responses and covers number systems, Boolean algebra, and logic gates, along with simple combinational circuits like adders. It also introduces sequential circuits, including flip-flops and counters, and concludes with a block diagram of an electronic instrumentation system.

COURSE OBJECTIVES:

The objectives of this course are to

1. To expose to the field of electrical & electronics engineering.
2. To understand the importance of electrical safety.
3. To teach the fundamentals of semiconductor devices and its applications.
4. To teach the working process and analysis of different rectifying and Amplifying Circuits.
5. To teach the fundamental principles and rules of digital electronic circuits like gates, Sequential and Combinational Circuits.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the problem-solving concepts associated to AC and DC circuits
CO2	Remember the fundamental laws, construction and operation of AC and DC machines, instruments.
CO3	Understand different power generation mechanisms, Electricity billing concept and important safety measures related to electrical operations.
CO4	Understand the fundamental principles of electronic devices, analyzing the different rectifying and Amplifying Circuits.
CO5	Analyze and design different digital electronic circuits like gates, Sequential and Combinational Circuits and Understand the basic Electronic instrumentation system.

COURSE CONTENT (SYLLABUS)

Part A-BASIC ELECTRICAL ENGINEERING

UNIT -I: DC & AC Circuits

DC Circuits: Electrical circuit elements (R, Land C), Ohm's Law and its limitations, KCL& KVL,series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Self-Learning Topics: Source Transformation

UNIT-II: Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

Self-Learning Topics: Magnetic materials.

UNIT-III: Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of house hold appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Self-Learning Topics: Different types of electrical tools.

Part B: ELECTRONICS ENGINEERING

UNIT-IV: Semiconductor Devices and Basic Electronic Circuits

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Breakdown Effects in diodes — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Introduction to Small Signal CE configuration. Rectifiers and power supplies: Block diagram description of a dc power supply, Half-Wave Rectifiers, Full-Wave Rectifiers, capacitor filter (no analysis). Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response.

Self-Learning Topics: Electronic components and characteristics, Design Amplifier circuit at different R, C Values

UNIT -V: DIGITAL ELECTRONICS and INSTRUMENTTAION

Overview of Number Systems, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits– Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only), Electronic Instrumentation: Block diagram of an electronic instrumentation system

Self-Learning Topics: Develop digital circuits using minimum no. of gates, design principles of electronic instruments.

TEXT BOOKS:

1. Basic Electrical Engineering, D.C.Kulshreshtha,Tata McGrawHill,2019,First Edition.
2. Power System Engineering, P.V.Gupta, M.L.Soni, U.S.Bhatnagar and A.Chakrabarti, Dhanpat Rai & Co, 2013.
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition
4. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
5. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

REFERENCE BOOKS :(Basic Electrical Engineering)

1. Basic Electrical Engineering, D.P.Kothari and I.J.Nagrath, McGrawHill, 2019,Fourth Edition.
2. Principles of Power Systems, V.K.Mehtha, S.Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S.Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Pearson Publications,2018, Second Edition.

REFERENCE BOOKS: Electronics Engineering

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall,India, 2002.
3. R.T.Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson

ONLINE RESOURCES:

Web References: (Basic Electrical Engineering)

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

Web References: (Electronics Engineering)

1. https://archive.nptel.ac.in/courses/108/101/108101091/
2. https://www.tutorialspoint.com/basic_electronics/index.htm
3. https://www.tutorialspoint.com/digital_circuits/index.htm

E-B OOKS:

1. https://www.pdfdrive.com/basic-electronics-for-scientists-and-engineers-e28939124.html

Engineering Chemistry Lab

I B.TECH-I SEMESTER

Course Title: Engineering Chemistry Lab	Course Code: R24BS08
Teaching Scheme(L:T:P): 0:0:2	Credits:1
Type of Course: Practical	Total Contact Periods: 2
Continuous Internal Evaluation:30Marks	Semester End Exam: 70Marks
Prerequisites: Basic Chemistry Knowledge, Stoichiometry and Concentration Calculations, Acids, Bases, and pH	

COURSE OVERVIEW:

To succeed in an ENGINEERING *CHEMISTRY Lab* course, certain foundational skills and knowledge are necessary for effective participation and understanding. Here are the key prerequisites:

1. Basic Chemistry Knowledge
2. Basic Laboratory Skills
3. Familiarity with safety practices

COURSE OBJECTIVES:

- Verify the fundamental concepts with experiments.
- Learn and carry out some of the important experiments related to batteries and their properties.
- Learn the preparation of engineering polymer materials like Bakelite
- Know the fundamental principles of chemistry lab experiments which include volumetric analysis, dichrometry, P^H metry

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Determine hardness of water , Dissolved Oxygen, Strength of an acid in Pb-Acid battery, ferrous iron, Calcium in port land Cement, Moisture content in a coal sample the cell constant and conductance of solutions.
CO2	Prepare advanced polymer Bakelite materials, nano materials by precipitation method, . Adsorption of acetic acid by charcoal
CO3	Determine the physical properties like surface tension, adsorption and viscosity, Conductometric titration of strong acid vs. strong base, . P^H metric titration Calorific value of gases by Junker's gas Calorimeter

COURSE CONTENT (SYLLABUS)

List of Experiments

1. Determination of Hardness of a groundwater sample.
2. Estimation of Dissolved Oxygen by Winkler's method
3. Determination of Strength of an acid in Pb-Acid battery
4. Preparation of a polymer (Bakelite)
5. Estimation of ferrous iron by Dichrometry
6. Estimation of Calcium in port land Cement
7. Preparation of nano materials by precipitation method.

8. Adsorption of acetic acid by charcoal
9. Determination of percentage Moisture content in a coal sample
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1
11. Conductometric titration of strong acid vs. strong base
12. P^H metric titration of strong acid vs. strong base

REFERENCE BOOKS:

Vogel's Quantitative Chemical Analysis 6th Edition" Pearson Publications by J.Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

Problem Solving & Programming with C Lab

I B.TECH- I SEMESTER (Common to all Branches)

Course Title: Problem Solving& Programming with C Lab	Course Code: R24ES03
Teaching Scheme (L:T:P): **0 0 3**	Credits: 1.5
Type of Course: Practical	Total Contact Periods: 3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Problem Solving & Programming with C lab include: Understanding programming fundamentals, Writing C programs, Applying programming techniques, Using algorithms, Using pseudocode and flowcharts.	

COURSE OVERVIEW:

1. To understand computer programming and its roles in problem solving.
2. To understand and develop well-structured programs using C language.

COURSE OBJECTIVES:

The objectives of this course are to:

The course aims to give students hands – on experience and train them on the concepts of the C-programming language.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Read, understand, and trace the execution of programs written in C language.
CO2	Select the right control structure for solving the problems .and demonstrate the application of arrays functions and strings
CO3	Develop Debug and Execute programs to demonstrate the applications of Pointers, Structures& Unions, and Files.

COURSE CONTENT (SYLLABUS)

Developing the following programs:

Week 1:

1. Write a C program using printf() and Scanf().
2. Write a C program on swapping of two nos.
3. Write a C program using arithmetic Expressions.

Week 2:

4. Simple interest calculation
5. Finding compound interest
6. Area of a triangle using heron's formulae
7. Distance travelled by an object

Week 3:

8. Find the maximum of three numbers using conditional operator

9. Take marks of 5 subjects in integers, and find the total, average in float
10. Write a C program to shift/rotate using bit fields.
11. Finding the square root of a given number
12. Write a C program using if-else statement.

Week 4:

13. Write a C program to find the max and min of four numbers using if-else.
14. Write a C program to generate electricity bill.
15. Find the roots of the quadratic equation. `
16. Write a C program to find the given year is a leap year or not.
17. Write a C program to simulate a calculator using switch case.

Week 5:

18. Find the factorial of given number using any loop.
19. Find the given number is a prime or not.
20. Compute sine and cos series.
21. Checking a number palindrome.
22. Construct a pyramid of numbers.

Week 6:

23. Write a C program on Linear Search.
24. Find the min and max of a 1-D integer array.
25. Perform linear search on1D array.
26. The reverse of a 1D integer array.

Week 7:

27. Find 2's complement of the given binary number.
28. Eliminate duplicate elements in an array.
29. Sort array elements using bubble sort.
30. Addition of two matrices.

Week 8:

31. Multiplication two matrices.
32. Write a C program using call by reference.
33. Write a C program to find factorial of n using recursion.
34. Write a C function to calculate NCR value
35. Concatenate two strings without built-in functions.

Week 9:

36. Write a C function to transpose of a matrix.
37. Write a C function to find the length of a string.
38. Reverse a string using built-in and without built-in string functions.
39. Write a C program to find the sum of a 1D array using malloc ( ).

Week 10:

40. Write a recursive function to find the lcm of two numbers.
41. Write a recursive function to find the sum of series.
42. Write a C program to swap two numbers using call by reference.
43. Write a C program using Pointers, Structures and Unions.
44. Write a C program to find the total, average of n students using structures.

Week 11:

45. Enter n students data using calloc() and display failed students list.
46. Read student name and marks from the command line and display the student details along with the total.
47. Write a C program to implement realloc().
48. Write a C program to copy one structure variable to another structure of the same type.

Week 12:

49. Demonstrate Dangling pointer problem using a C program.
50. Write a C program to copy one string into another using pointer.
51. Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

Week 13:

52. Write a C program using Files operations.
    a. Sum and average of 3 numbers
    b. Conversion of Fahrenheit to Celsius and vice versa.
53. Write a C program to write and read text into a file.

Week 14:

54. Write a C program to write and read text into a binary file using fread() and fwrite()
55. Copy the contents of one file to another file.
56. Write a C program to merge two files into the third file using command-line arguments.

Week 15:

57. Find no. of lines, words and characters in a file.
58. Write a C program to print last n characters of a given file.

<u>Scenario Based Case Study:</u>

1. Objective: To develop a simple utility program to calculate the area of geometric shapes.

   Target Audience: Beginner programmers and students.

A basic utility program in C that can:

1. Calculate the area of a circle.
2. Calculate the area of a rectangle.
3. Calculate the area of a triangle.

The program should be easy to understand and serve as an educational tool for new programmers.

1. Program Design:

The utility program will be designed with a simple menu-driven interface allowing the user to select the shape for which they want to calculate the area. The program will then prompt the user to input the necessary dimensions and display the result.

This basic C program demonstrates fundamental programming concepts such as variables, functions, and control structures in a practical context. It provides a clear introduction to C programming for beginners by solving a simple problem using these core concepts.
This case study outlines a straightforward approach to teaching and implementing basic C programming concepts effectively.

2. Students Marks Sum Hacker Rank Solution

You are given an array of integers, marks, denoting the marks scored by students in a class.

- The alternating elements marks0, marks2, marks4 and so on denote the marks of boys.
- Similarly,marks1, marks3, marks5 and so on denote the marks of girls.

The array name, marks, works as a pointer which stores the base address of that array. In other words, marks contains the address where marks0 is stored in the memory.

3. Sorting Array of Strings HackerRank Solution

To sort a given array of strings into lexicographically increasing order or into an order in which the string with the lowest length appears first, a sorting function with a flag indicating the type of comparison strategy can be written. The disadvantage with doing so has to rewrite the function for every new comparison strategy.

A better implementation would be to write a sorting function that accepts a pointer to the function that compares each pair of strings. Doing this will mean only passing a pointer to the sorting function with every new comparison strategy.

Textbooks:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

Basic Electrical and Electronics Engineering Lab

I B.TECH- I SEMESTER (Common to ECE ,EEE & Mech)

Course Title: Basic Electrical and Electronics Engineering Lab	Course Code: R24ES07
Teaching Scheme (L:T:P): 0:0:3	Credits: 1.5
Type of Course: Practical	Total Contact Periods:3
Continuous Internal Evaluation:30 Marks	Semester End Exam: 70 Marks
Pre requisites: Understanding of Circuit Components, Breadboard connections.	

COURSE OVERVIEW:

- In this lab, the students of all engineering streams are trained on basic concepts of electrical engineering, such as DC circuits, AC circuits, Resonance for series RLC and Parallel RLC circuit, AC to DC conversion, measurement, Efficiency and voltage regulation of transformer, electrical machines, verification of basic laws and theorems.

COURSE OBJECTIVES:

The objectives of this course are to impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Apply the theoretical concepts and operating principles to derive mathematical models for circuits, Electrical machines and measuring instruments; calculations for the measurement of resistance, power and power factor.
CO2	Apply the theoretical concepts to obtain calculations for the measurement of resistance, power and power factor.
CO3	Plot and discuss the characteristics of various electron devices/instruments.
CO4	Design suitable circuits and methodologies for the measurement of various electrical parameters; Household and commercial wiring.
CO5	Understand the usage of electronic measuring instruments.
CO6	Plot and discuss the characteristics of various electron devices.

List of Experiments:

Part A-Basic Electrical Engineering

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Verification of ohms law
7. Calculation of Electrical Energy for Domestic Premises

Part B: Basic Electronics Engineering

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations

5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gatesusing ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

REFERENCE BOOKS:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition
4. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education,2021.
5. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
6. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

Engineering Workshop

I B.TECH- I SEMESTER (Common to All Branches)

Course Title : Engineering Workshop	Course Code: R24ES08
Teaching Scheme (L:T:P): 0:0:3	Credits: 1.5
Type of Course: Practical	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Materials, Tools, Engineering Drawing, Safety Awareness	

COURSE OVERVIEW:

- The Engineering Workshop Lab introduces students to essential hands-on skills across multiple trades, fundamental for understanding material manipulation, joining techniques, and assembly processes. Through eight core experiments, students learn woodworking, sheet metal fabrication, fitting, foundry molding, welding, electrical wiring, plumbing, and blacksmithing. These exercises build practical knowledge in creating structures, forming metal parts, achieving precision fits, casting molds, and assembling electrical and plumbing systems. This workshop lays a solid foundation for understanding and applying basic engineering processes, crucial for practical problem-solving and project execution in various engineering fields.

COURSE OBJECTIVES:

The objectives of this course are to

- Describe how different tools are used in home wiring, tin smiting, blacksmithing, carpentry, and fitting.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Identify workshop tools and their operational capabilities. Practice on manufacturing of components using workshop trades including carpentry, fitting, sheet metal
CO2	Practice on manufacturing of components using workshop trades including foundry and welding.
CO3	Apply fitting operations in various applications and engineering knowledge for Plumbing, House Wiring Practice, and Making square rod and L-bend from the round rod in black smithy

COURSE CONTENT (SYLLABUS)

1. **Wood Working**
   a) Half Lap joint
   b) Mortise and Tenon joint
   c) Corner Dovetail joint or Bridle joint
2. **Sheet Metal Working**
   a) Tapered tray
   b) Conical funnel
   c) Elbow pipe
   d) Brazing

3. **Fitting**
   a) V- fit
   b) Dovetail fit
   c) Semi-circular fit
   d) Bicycle tire puncture and change of two-wheeler tyre
4. **Foundry Trade:** Preparation of Green Sand Moulds
   a) Single piece pattern
   b) Double piece pattern
5. **Welding Shop: Arc welding Practice**
   a) Lap joint
   b) Butt joint
6. **Electrical Wiring**
   a) Parallel and series connection
   b) Two-way switch connection
   c) Tube light connection
   d) Soldering of wires
7. **Plumbing**
   a) Prepare Pipe joint with coupling for 1 inch diameter
   b) Prepare Pipe joint with coupling for 1.5inch diameter
8. **Black smithy**
   a) Round rod to Square
   b) Round rod to S-Hook

TEXT BOOKS:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 &2017

REFERENCE BOOKS:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan 2021-22

ONLINE RESOURCES:

1. https://youtube.com/playlist?list=PLzkMouYverALpuDJ4g4TiICc6_vLcS1Ny&si=YGrVJY8uB0tHy_iQ

E-B OOKS:

1. https://www.pdfdrive.com/workshop-processes-practices-and-materials-third-edition-d158706794.html
2. https://www.pdfdrive.com/introduction-to-basic-manufacturing-processes-and-workshop-e217530.html
3. https://www.pdfdrive.com/workshop-technology-e55714020.html

HEALTH AND WELLNESS, YOGA AND SPORTS

I B.TECH- I SEMESTER (Common to All Branches)

Course Title: Health and Wellness, Yoga & Sports	Course Code: R24MC01
Teaching Scheme (L:T:P): 0:0:1	Credits: 0.5
Type of Course: Practical	Total Contact Periods:1
Continuous Internal Evaluation: 100	Semester End Exam: 0
Pre requisites: Mental Health Awareness, Physical Education Background	

COURSE OVERVIEW:

- The course on "Health and Wellness, Yoga & Sports" is designed to promote a comprehensive understanding of health, wellness, fitness, nutrition, and the significance of yoga and sports in maintaining a balanced lifestyle. It covers fundamental aspects such as dietary awareness, fitness metrics, the influence of global trends on health, and the importance of physical and mental well-being through yoga and sports activities. The course fosters hands-on learning through interactive activities, community engagement, and practical sessions.

COURSE OBJECTIVES:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the importance of yoga and sports for Physical fitness and sound health.
CO2	Demonstrate an understanding of health-related fitness components.
CO3	Compare and contrast various activities that help enhance their health
CO4	Assess current personal fitness levels.
CO5	Develop Positive Personality

COURSE CONTENT (SYLLABUS)

UNIT -I:

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT-II:

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT-III:

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
   Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject

Differential Equations and Vector Calculus
I B.TECH- II SEMESTER (Common to all Branches)

Course Title: Differential Equations and Vector Calculus	Course Code: R24BS04
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods: 3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: To succeed in Differential Equations and Vector Calculus, you'll need a strong foundation in several key areas of mathematics. Here are the typical prerequisites: Calculus I (Single-variable Calculus), Calculus II (Single-variable Calculus, continuation), Calculus III (Multivariable Calculus), Linear Algebra.	

COURSE OVERVIEW:

- This course is often taken after completing Calculus I, II, and III, and Linear Algebra. It combines methods and applications of differential equations with essential topics in vector calculus, as used in fields like physics, engineering, and applied mathematics.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To enlighten the learners in the concept of differential equations and multivariable calculus.
2. To furnish the learners with basic concept and techniques at plus two level to lead them in to advanced level by handling various real-world applications.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Solve the first order differential equations related to various engineering fields.
CO2	Model engineering problems as higher order differential equations and solve analytically.
CO3	Identify solution methods for partial differential equations that model physical processes.
CO4	Interpret the physical meaning of different operators such as gradient, curl and divergence.
CO5	Estimate the work done against a field, circulation and flux using vector calculus.

COURSE CONTENT (SYLLABUS)

UNIT- I: Differential equations of first order and first degree

Formation of differential equations, order, degree, separation of variables (only Review). Linear differential equations-Bernoulli's equations-Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling – Law of natural growth and decay, Electrical circuits (RL and LC).

Self-Learning Topic: Mixed tank problems

UNIT- II: Higher order Linear differential equations with Constant Coefficients

Definitions, homogenous and non-homogenous, complimentary function, particular integral $\left(e^{ax}, \sin ax, \cos ax, \text{Polynomial in } x, e^{ax}V(x), xV(x)\right)$, general solution, Wronskian, method of variation of parameters.

Applications: L-C-R Circuit problems

Self-Learning Topic: Simple Harmonic motion

UNIT–III: Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solution of first order linear equations using Lagrange's method. Homogenous Linear Partial differential equations with constant coefficients.

Self-Learning Topic: Method of Separation of Variables

UNIT- IV: Vector differentiation

Vector, Scalar, dot product, cross product, unit vector, equation of a line passing through two points (Review only)

Scalar and vector point functions, vector operator del, del applies to scalar point function-Gradient, del applied to vector point function – Divergence and Curl, Vector Identities

Application: Scalar Potential

Self-Learning Topic: Equation of tangent plane and Normal plane.

UNIT-V: Vector integration

Line integral – circulation – work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

Self-Learning Topic: Application of above theorems.

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

Reference Books:

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2. Michael Green berg, Advanced Engineering Mathematics, 9th edition, Pearson edn
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science
5. International Ltd., 2021 (9th reprint).
6. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017.

Web References:

1. http://onlinecourses.nptel.ac.in
2. https://nptel.ac.in/courses/111105121
3. https://onlinecourses.nptel.ac.in/noc24_ma86/course

Engineering Physics

I B.TECH- II SEMESTER (Common to ECE,EEE,MEC)

Course Title: Engineering Physics	Course Code: R24BS02
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Basic Physics, Mathematics, Measurements & Units	

COURSE OVERVIEW:

- An Engineering Physics course is typically designed to bridge the gap between theoretical physics principles and engineering applications, providing students with a solid foundation to analyze and solve complex engineering problems.

COURSE OBJECTIVES:

The objectives of this course are to

1. Bridge the gap between the physics in school at 10+2 level and UG level engineering courses.
2. Identify the importance of the optical phenomenon i.e. interference and diffraction related to its engineering applications.
3. Understand the mechanism of emission of light, utilization of lasers as coherent light sources for lowand high energy applications.
4. Enlightening the periodic arrangement of atoms in crystalline solids and classify variouscrystal systems.
5. Explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
6. Enlightenment of the concepts of quantum mechanics and to provide fundamentals of de-Broglie matter waves and the importance of free electron theory for metals.
7. Understand the physics of semiconductors and identify the type of semiconductor using Halleffect.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Analyze the intensity variation of light due to interference, diffraction and classify varioustypes of lasers.
CO2	Identify various crystal systems and analyze the crystalline structure.
CO3	Summarize various types of polarization of dielectrics and classify the magnetic materials.
CO4	Explain fundamentals of quantum mechanics and apply to one dimensional motion ofparticles.
CO5	Outline the properties of charge carriers in semiconductors

COURSE CONTENT (SYLLABUS)

UNIT-I Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit- Fraunhofer diffraction due to N Slits -Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative).

Lasers: Introduction–Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Population inversion – Lasing action - Pumping mechanisms – Ruby laser –He-Ne laser- Applications of lasers. **COs – CO1**

Self-Learning Topics: Interference in thin films due to Transmission of light

UNIT-II Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D)– coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive(hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powdermethods.

Self-Learning Topics: Effect of crystallite size on diffracted X-Ray intensity.

UNIT-III Magnetic and Dielectric Materials

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro& Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector –Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius-Mossotti equation–dielectric loss.

Self-Learning Topics: Frequency dependence of polarization.

UNIT-IV Quantum Mechanics and Free electron theory

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory –electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Fermi energy.

Self-Learning Topics: Density of states, Origin of energy bands in solids

UNIT-V Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors:– Fermi level – Extrinsic semiconductors- P-Type semiconductors- N-Type semiconductors- principle of operation and characteristics of P-N Junction diode - Drift and diffusion currents –Einstein's equation - Hall effect and its applications.

Self-Learning Topics: Zener diode, Solar cells

TEXT BOOKS:

1. "ATextbook of EngineeringPhysics"by M.N. Avadhanulu, P.G.Kshirsagar-S.Chand Publications, 2017.
2. "Engineering Physics" byD. K. Bhattacharya and PoonamTandon,Oxfordpress (2015).
3. "Engineering Physics"byR.KGaur.and S.LGupta.,-Dhanpat Rai publishers, 2012.

REFERENCE BOOKS:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning.
2. The Principles of Quantum Mechanics, P. A. M. Dirac, fourth Edition (Oxford UniversityPress,Oxford, 1958).
3. Physics-Resnick, Halliday, Krane, Fifth edison, Volume-1, Wiley student edition.
4. Engineering Physics - Dr.R. Swapna, Scientific International Publishing House.
5. Concepts of Modern Physics. Arthur Beiser, Tata McGraw-Hill, New Delhi (2010).
6. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.
7. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

ONLINE RESOURCES:

Web References:

1. https://www.ebooksdirectory.com/
2. http://www.sciencedirect.com/Science
3. https://onlinecourses.nptel.ac.in/
4. https://www.link.springer.com/physics/
5. https://www.loc.gov/rr/scitech/selected-internet/physics.html

E-BOOKS:

1. https://www.ebooksdirectory.com/

COMMUNICATIVE ENGLISH
I B.TECH- II SEMESTER (Common to All Branches)

Course Title: COMMUNICATIVE ENGLISH	Course Code: R24HS01
Teaching Scheme (L:T:P): **2 0 0**	Credits: 2
Type of Course: Lecture	Total Contact Periods: 2
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: To excel in a Communicative English course, certain foundational skills and prerequisitesare helpful such as Basic Grammar Knowledge, Listening Skills, Basic Vocabulary, Reading Comprehension, Confidence in Speaking, Writing Skills.	

COURSE OVERVIEW:

A Communicative English course is designed to develop students' proficiency in spoken and written English through practical and interactive learning methods. The course focuses on improving students' ability to communicate effectively in real-life situations, emphasizing both fluency and accuracy.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To identify the English Communication Skills among the first year B.Tech students and to initiate measures to bridge the gap.
2. To enlighten the students on the necessity of cultivating good language habits through practicing LSRW skills.
3 To explain them various topics of grammar and the importance of being grammatically correct in speech and writing.
4 To make them practise Phonetics and impart the nuances of fine speech.
5 To instruct them about the various types of format related to writing letters, paragraph, emails, essays and reports.
6 To make them appreciate English text and deepen their comprehension through reading of textual and non-detailed topics.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	To utilize the text, online resources, and other social, and real time situations with an aim to practice Communicative English
CO2	To apply grammatical knowledge for speaking, and writing purposes
CO3	To analyze and practice various devices of speech for effective conversation and presentations
CO4	Appraising the language competence of the learners and suggesting remedial action
CO5	To make the learners practice writing tasks which are relevant for job training and academic purposes.

COURSE CONTENT (SYLLABUS)

UNIT-I

Lesson: HUMAN VALUES: A Power of a Plate of Rice by Ifeoma Okoye (Short story)

Listening: Identifying the topic, the context and specific pieces of information
By listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

Self learning topics: The Great Indian Scientists-Biography of CV Raman

UNIT-II

Lesson: NATURE: Night of the Scorpion by Nissim Ezekiel (Indian and contemporary)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics)

Grammar: Cohesive devices-linkers, use of articles and zero article prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

Self learning Topics : Seven Ages of Man by William Shakespeare.

UNIT-III

Lesson: BIOGRAPHY: Steve Jobs

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences-recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs-tenses; Subject-verb agreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

Self learning topics: Elon Musk

UNIT-IV

Lesson: INSPIRATION: The Knowledge Society by APJ Abdul Kalam (Ignited minds)

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/ patterns / relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters and Resumes
Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice
Vocabulary: Words often confused, Jargons
Self learning Topics: The writings of Sudha Murthy- “The day I stopped drinking milk”

UNIT-V

Lesson: MOTIVATION: The Power of Intra personal Communication (An Essay)
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal Oral Presentation topics from academic contexts
Reading: Reading comprehension.
Writing: Writings structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject-verb agreement)
Vocabulary: Technical Jargons
Self learning Topics: Body Language (Allan Pease)

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1stEdition,Orient BlackSwan, 2023 (Units 1,2,3 &5)
2. Empowering English by Cengage Publications, 2023
3. The Great Indian Scientists-Cengage Publications
4. English Essentials- Maruthi Publications.(Unit 4)

Reference Books:

1. P. Elian : A Hand book of English for Engineers and Technologists,
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy Raymond English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. English for Engineers by Shyam Ji Dubey- Vikas Publishing House

Web References:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx
7. https://www.youtube.com/c/DailyVideoVocabulary/videos
8. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

BASIC CIVIL AND MECHANICAL ENGINEERING

I B.TECH- II SEMESTER (Common to ECE, EEE & MECH)

Course Title: Basic Civil and Mechanical Engineering	Course Code: R24ES01
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Physics, Chemistry, Mathematics, Environmental Science, Drawing	

COURSE OVERVIEW:

- Basic Civil and Mechanical Engineering course provides a broad foundation for all engineering disciplines, equipping students with a holistic understanding of the principles, design methods, and innovations shaping each branch, fostering interdisciplinary knowledge and skills.
- This introductory course covers fundamental concepts in Civil and Mechanical Engineering, emphasizing their roles in society and diverse applications. In Civil Engineering, students explore various disciplines, including structural, transportation, water resources, and environmental engineering, along with essential materials and construction techniques, surveying, and advancements in sustainable practices.
- The Mechanical Engineering segment introduces students to core sectors such as energy, manufacturing, and automotive, along with basic design principles and engineering materials. Key topics include thermal engineering, power cycles, IC engines, and power plant operations, as well as principles in manufacturing, CNC, 3D printing, and robotics. This course provides a foundational understanding of both fields, preparing students for more specialized study and practical applications in engineering.

COURSE OBJECTIVES:

The objectives of this course are to

1. **Understand the Role of Civil Engineers**: Familiarize students with the roles and responsibilities of civil engineers in society and the various sub-disciplines within civil engineering.
2. **Construction Materials**: Provide knowledge about different construction materials such as cement, aggregates, bricks, concrete, steel, soil, stones and their applications in building construction.
3. **Transportation Engineering**: Offer insights into the importance of transportation engineering for national economic development and the fundamentals of highway pavements, harbor, tunnel airport and railway engineering.
4. **Water Resources and Environmental Engineering**: Cover the basics of water sources, water quality specifications, hydrology, rainwater harvesting, and water storage structures, emphasizing their importance in environmental sustainability.
5. **Scope and Importance of Mechanical Engineering**: Familiarize students with the scope and significance of mechanical engineering in various sectors, including energy, manufacturing, automotive, aerospace and marine industries.
6. **Engineering Materials and Manufacturing Processes**: Explain different engineering materials and various manufacturing processes and computational manufacturing.
7. **Thermal Engineering**: Provide an overview of thermal engineering principles, including the working of boilers, IC engines, and power plants, and introduce concepts related to electric and hybrid vehicles.

8. **Mechanical Power Transmission Systems**: Describe different mechanical power transmission systems such as belt drives, chain drives, gear drives, and their applications.
9. **Basics of Robotics**: Introduce the basics of robotics, including joints, links, configurations, and applications, along with advancements in robotics technology.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the role of civil engineers in various disciplines, the scope of each discipline, and the materials used in building construction and principles of surveying.
CO2	Describe the fundamentals of transportation engineering, water resources, and environmental engineering, including highway pavements, water quality, hydrology, and water storage structures.
CO3	Understand and apply different manufacturing processes and engineering materials, including their applications, and basic mechanical design principles.
CO4	Explain the basics of thermal engineering, including working principles of engines, power plants, and related thermal cycles, along with their applications.
CO5	Describe the working of different mechanical power transmission systems and the basics of robotics and their applications.

COURSE CONTENT (SYLLABUS)

UNIT -I:

Role of Civil Engineers in Society, Various Disciplines of Civil Engineering, Structural Engineering, Geo-technical Engineering, Transportation Engineering, Hydraulics and Water Resources Engineering, Environmental Engineering, Scope of Each Discipline, Building Construction and Planning, Construction Materials Cement, Aggregate, Bricks, Cement Concrete-Steel, soils and stones. Introduction to Prefabricated construction Techniques.

Surveying: Objectives of Surveying, Horizontal Measurements, Angular Measurements, Introduction to Bearings Simple problems on bearings-Contour mapping.

Self-Learning Topic: Advancements in Prefabricated Construction Techniques

UNIT-II:

Transportation Engineering: Importance of Transportation in Nation's economic development, Types of Highway Pavements, Flexible Pavements and Rigid Pavements, Simple Differences. Basics of Harbor, Tunnel, Airport, and Railway Engineering

Water Resources and Environmental Engineering: Introduction, Sources of water, Quality of water, Specifications, Introduction to Hydrology, Rainwater Harvesting, Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Self-Learning Topic: Sustainable Transportation Engineering

UNIT-III:

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Basic Mechanical Design Principles: Fundamentals of Mechanical Design- Introduction to the design process, understanding design requirements, and conceptual design, Design of Simple Machine Components - Design considerations for basic machine components like shafts, bearings, gears, and fasteners.

Engineering Materials – Metals - Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

Self-Learning Topics: Sustainable Engineering Practices, Advancements in Smart Materials.

UNIT-IV:

Thermal Engineering–Working principle of Boilers

Cycles- Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles,

Engines-IC engines, 2-Stroke and 4-Strokeengines, SI/CI Engines,

Power plants – Working principle of Steam, Diesel, Hydro, Nuclear power plants, Introduction to Electric and Hybrid Vehicles.

Self-Learning Topics: Advanced Engine Technologies, Thermodynamics in Renewable Energy Systems.

UNIT-V:

Manufacturing Processes: Principles of Casting, Forming, joining processes,

Computational Manufacturing: Introduction to CNCmachines,3Dprinting and Smart manufacturing.

Machining– Conventional & Non-Conventional,

Mechanical Power Transmission-Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics-Joints & links, configurations, and applications of robotics.

Self-Learning Topics: Additive Manufacturing Technologies, Innovations in Mechanical Power Transmission

TEXT BOOKS:

1. Basic Civil and Mechanical Engineering, by Ommi Srikanth, M.Sreenivasa Reddy S. Chand Publications
2. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
3. A Text book of Theory of Machines by S.S.Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
4. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, cengage learning India pvt. Ltd.

REFERENCE BOOKS:

1. Appuu Kuttan K K, Robotics, I.K.International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata Mc graw Hill publications (India)Pvt. Ltd.
4. G.Shanmugam and M.S.Palanisamy,Basic Civil and the Mechanical Engineering, Tata Mcgraw Hill publications (India) Pvt. Ltd.

ONLINE RESOURCES:

1. https://www.youtube.com/playlist?list=PLyqSpQzTE6M_SM0Lrnzk2dJFwElh0Ebhu
2. https://nptel.ac.in/courses/105101087
3. https://archive.nptel.ac.in/courses/105/105/105105110/
4. https://archive.nptel.ac.in/courses/112/105/112105125/
5. https://www.youtube.com/watch?v=-cr5vfV4YAI
6. https://nptel.ac.in/courses/112105266
7. https://archive.nptel.ac.in/courses/112/104/112104301/

E-B OOKS:

1. https://www.pdfdrive.com/basics-of-mechanical-engineering-prof-paul-d-ronney-e16452684.html

Engineering Mechanics
I B.TECH- II SEMESTER

Course Title: Engineering Mechanics	Course Code: R24MEPC01
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	Total Contact Periods: 3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Physics, Basic Mechanics, Mathematics, Statics, Dynamics.	

COURSE OVERVIEW:

- Engineering Mechanics provides a foundation in understanding and analyzing forces, motion, and equilibrium, essential across engineering disciplines. Through five structured units, students explore force systems, equilibrium conditions, friction, and motion principles, both for particles and rigid bodies. Topics include calculating centers of gravity, moments of inertia, and applying methods like Work-Energy and Impulse-Momentum to solve real-world engineering problems.

COURSE OBJECTIVES:

The objectives of this course are to

1. To get familiarized with different types of force systems.
2. To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
3. To teach the basic principles of center of gravity, centroid and moment of inertia and determine them for different simple and composite bodies.
4. To apply the Work-Energy method to particle motion
5. To understand the kinematics and kinetics of translational and rotational motion of rigid bodies.
6. Able to analysis of frames and trusses, different types of motion, friction and application of work - energy method.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.
CO2	Analyze different force systems such as concurrent non concurrent systems and calculate their resultant forces and moments.
CO3	Calculate the Centroids, Centre of gravity and moment of inertia of different geometrical shapes.
CO4	Determine the displacement, velocity & acceleration relations in dynamic systems.
CO5	Analyze the motion of the bodies with(or) without the application of force.

COURSE CONTENT (SYLLABUS)

UNIT -I:

Introduction to Engineering Mechanics – Basic Concepts and Applications.

Systems of Forces: Coplanar Concurrent Forces– Components in Space– Resultant–Moment of Force and its Application –Couples and Resultant of Force Systems.

Friction: Introduction**,** limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Cone of Static friction.

Self learning topic: Newton's law of motion and gravitation

UNIT-II:

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses. Principle of virtual work with simple examples

Self learning topic: Distribution of forces in a plane

UNIT-III:

Centroid, Centre of Gravity and Area moments of Inertia

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Fig

Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.

Area Moments of Inertia: Definition–Polar Moment of Inertia, Transfer Theorem, Moments ofInertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Self learning topic: Centroid for two dimensional bodies

UNIT-IV:

Kinematics and Kinetics

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's principle – Work Energy method and applications to particle motion-Impulse Momentum method

Self learning topic: Cylindrical and spherical coordinates

UNIT-V:

Work – Energy Method

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method

Self learning topic: Potential energy and equilibrium

TEXT BOOKS:

1. Timoshenko S. and Young D.H.," Engineering Mechanics",5th Edition, Mc Graw HillPublications,2013
2. Bavakatti S. S.," Engineering Mechanics Statics",4th Edition, New Age InternationalPublications,2012
3. Tayal. A. K., "Engineering Mechanics Statics and Dynamics",6th Edition, UmeshPublications,2006

REFERENCE BOOKS:

1. Kurmi R.S.,"Engineering Mechanics Statics",10thEdition, S.Chand Publications,2005
2. Vijay Kumar Reddy K. and Suresh KumarJ.," Mechanics: Statics and Dynamics",3rdEdition, B S Publications,2010
3. Ferdinand P. Beer, Russell Johnston Jr.E.," Vector Mechanics for Engineers Static sandDynamics",9th Edition, McGraw Hill Publications,2011

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106286/
2. https://archive.nptel.ac.in/courses/112/106/112106180/
3. https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-me01/.
4. https://onlinecourses.nptel.ac.in/noc24_me02/preview
5. https://www.iitg.ac.in/rkbc/me101/Presentation/L01-03.pdf

E-B OOKS:

1. https://www.pdfdrive.com/stress-strain-and-structural-dynamics-an-interactive-handbook-of-formulas-solutions-and-matlab-e156943613.html
2. https://www.pdfdrive.com/vector-mechanics-for-engineers-statics-and-dynamics-e157261014.html

COMMUNICATIVE ENGLISH LAB
I B.TECH- II SEMESTER (Common to All Branches)

Course Title: COMMUNICATIVE ENGLISH LAB	Course Code: R24HS02
Teaching Scheme (L:T:P): **0 0 2**	Credits: 1
Type of Course: Practical	Total Contact Periods: 2
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: To excel in a Communicative English course, certain foundational skills and prerequisites are helpful such as Basic Grammar Knowledge, Listening Skills, Basic Vocabulary, Reading Comprehension, Confidence in Speaking, Writing Skills.	

COURSE OVERVIEW:

A Communicative English course is designed to develop students' proficiency in spoken and written English through practical and interactive learning methods. The course focuses on improving students' ability to communicate effectively in real-life situations, emphasizing both fluency and accuracy.

COURSE OBJECTIVES:

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. Students undergo training in basic communication skills to make them into confident communicators in all situations.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand and recognize the various facets of English language ability with a focus on the four basic skills- namely -LSRW abilities.
CO2	Implement various activities for language learners to practise communication skills.
CO3	To enhance listening and speaking comprehension, analyze the sounds, stress, rhythm, intonation, and syllable division of English speech.
CO4	Assess the professionalism of students when taking part in group discussions, debates, JAM sessions, Presentations and Interviews.
CO5	Equipping oneself with Interview Skills and a range of Soft Skills for life and career.

COURSE CONTENT (SYLLABUS)

Week1:
1. To explain and guide the students in decoding the sounds of English.
2. List all the consonant sounds and vowel sounds in English

Week2:
1. What is a syllable and describe the syllable structure.
2. Define stress, functional stress and various rules of stress.
3. What is connected speech?

Week3:

1. What is Intonation and mention the various pitch movements like rise, fall, fall-rise or rise-fall?
2. What is connected speech?

Week4:

1. To equip students to speak in English language confidently without any inhibitions.
2. Why are majority of the companies conducting JAM session as a preliminary interview?
3. What are the key skills tested in JAM round?

Week5:

1. To help students learn and understand different functions of language like greeting, asking
2. For information, giving information, meetings, requests, exchanging dialogues in formal and informal contexts.
3. Introduce yourself and others, give instructions and directions

Week 6:

1. To help the students understand and work on the digital age connector for personal correspondence, business communication, etc.
2. Write about email etiquette.
3. Draft an email to the HR Manager of Wipro Technologies requesting to consider your application for the post of Software Engineer.

Week 7:

1. To update students about the importance of Resume, the various types and the essentials of an effective resume
2. Draft a resume for a software post in reputed organization.

Week 8:

1. To educate students about the various styles of writing formal letters.
2. What is a cover letter? What are the different types of cover letters?
3. Write a job application letter for any post of your choice in a reputed company?

Week 9:

1. To help students know the importance of an SOP in their professional advancements?
2. What is an SOP and what are the different kinds and parts of an SOP?
3. Prepare an SOP to apply for a Master's Programme in any University of your choice.

Week 10:

1. To educate and guide the students about presentation skills and its importance in the technical evolving world.
2. To inform explain students about the importance of body language in various personal and professional forums
3. To help students to present papers, PPT's in seminars, workshops, conferences, research projects, interviews, etc.

Week 11:

1. To help students to give effective PPT's in various academic and professional platforms.
2. Describe various aspects that make PPT more effective.
3. Make a PPT on any topic of your choice and present it to the class.

Week 12:

1. To foster, creative, critical thinking skills, analytical skills and problem solving skills.
2. Suggest a few tips for preparing a poster.
3. Prepare posters from or outside your curriculum.

Reference Books:

1. Prof. M. Hari Prasad, Prof. Vijaya Babu, Prof. Padmaja Kalapala, Skill Craft – A Communicative English Laboratory Workbook, Maruthi Publications first Edition, 2023
2. Meenakshi Ramana, Sangeeta-Sharma, 4thEdition, Technical Communication, Oxford Press, 2022.
3. Grant Taylor: English Conversation Practice, 1st Edition, Tata ,Mc Graw-Hill Education India, 2001.
4. Hewing,s, Martin, Cambridge Academic English(B2), Cambridge University Press,2012.
5. T. Balasubramanyam, A Textbook of English Phonetics for Indian Students, 3rd Edition, Trinity, 2022.
6. Dr. ShaliniSharma's Body Language Your Success Mantra, S. Chand publications 2010.
7. Sunitha Mishra and C.Murali Krishna's Communication Skills for Engineers Pearson Education Edition 2009.

Suggested software:

- English Wordsworth –Language Lab- Wordsworth Software

Web References for:

Spoken English

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
7. https://www.youtube.com/c/engvidAdam/featured
8. https://www.youtube.com/c/EnglishClass101/featured
9. https://www.ted.com/watch/ted-ed
10. http://www.edest.org/

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Engineering Physics Lab

I B.TECH- II SEMESTER (Common to ECE,EEE,MEC)

Course Title: Engineering Physics lab	Course Code: R24BS03
Teaching Scheme (L:T:P): 0:0:2	Credits: 1
Type of Course: Practical	Total Contact Periods:2
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Basic Physics, Mathematics, Measurements & Units	

COURSE OVERVIEW:

- To succeed in an Engineering Physics Lab course, certain foundational skills and knowledge are necessary for effective participation and understanding. Here are the key prerequisites:

1. Basic Physics Knowledge
2. Mathematics Skills
3. Measurement and Unit Conversions
4. Basic Laboratory Skills
5. Problem-Solving and Analytical Skills
6. Familiarity with Safety Practices
7. Basic Computing Skills

COURSE OBJECTIVES:

1. To study the concepts of optical phenomenon like interference, diffraction etc.,
2. To recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors
3. To study the parameters and applications of dielectric and magnetic materials by conducting experiments.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Demonstrate the modern engineering physics Techniques and tools in real times applications in engineering studies.
CO2	Develop the laboratory skills in handling of electrical and optical instruments.
CO3	Conduct experiment Independently and In team to record the measurements
CO4	Compare the experimental results with standard values and estimate errors

COURSE CONTENT (SYLLABUS)

List of Experiments

1. Determination of radius of curvature of a given plano convex lens by Newton’sring;s method.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.

3. Determination of wavelength of Laser Source by diffraction gratting.
4. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
5. Magnetic field along the axis of a current carrying circular coil by Stewart & Gee's Method.
6. Determination of dispersive power of the prism.
7. Determination of acceleration due to gravity and radius of Gyration by using Compound pendulum.
8. Determination of energy gap of a semiconductor using p-n junction diode.
9. Determination of dielectric constant using charging an discharging method.
10. Sonometer: Verification of laws of stretched string.
11. Estimation of Planck's constant using photoelectric effect.
12. Study the variation of B versus H by magnetization the magnetic material (B-H curve)
13. Determination of frequency of electrically maintained tunning fork by Melde's experiment.
14. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
15. Determination of the resistivity of semiconductor by four probe method.
16. Determination of young's modulus for the given material of wooden scale by non- uniform bending (or double cantilever) method .
17. Determination of magnetic susceptibility by Kundt's tube method

REFERENCE BOOKS:

1. S. Balasubramanian, M.N.Srinivasan "A Text Book of Practical Physics"-S ChandPublishers,2017.
2. J.Raja Gopalam Patnaik, "Physics Laboratory Manual for Undergraduate Students "Paramount Book Disributors 2023.

ONLINE RESOURCES:

Web References:

1. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

URL:www.vlab.co.in

IT Workshop

I B.TECH- II SEMESTER (Common to ECE,EEE & MECH)

Course Title: IT Workshop	Course Code: R24ES04
Teaching Scheme (L:T:P): 0 0 2	Credits: 1
Type of Course: Practical	Total Contact Periods: 2
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: Familiarity with hand tools, equipment, and machines, Computer skills.	

COURSE OVERVIEW:

1. To understand computer programming and its roles in problem solving.
2. To understand and develop well-structured programs using C language.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To assemble and disassemble a computer.
2. To solve hardware and software problems.
3. To learn about Networking of computers and use Internet facility for Browsing and Searching.
4. To develop project documentation using MS word
5. To work with various productivity tools including Excel, PowerPoint.
6. To work with different online repositories such as GITHUB, AI CHATBOT.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Perform Hardware troubleshooting and Perform Hardware troubleshooting
CO2	Apply different way of hooking the PC on to the internet from home and Workplace.
CO3	Design word documents by learning word processing and Create presentations by using different styles and using AI Tools-Chat GPT and GITHUB

COURSE CONTENT (SYLLABUS)

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the Block diagram of the CPU along with the configuration of each peripheral and submit it to your Instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab Instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab Instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. Lab instructor should verify the installation and follow it up with a Viva.

Internet &World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students Should demonstrate to the instructor, how to access the websites and email. If there is no internet Connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN Proxy settings, bookmarks, search toolbars and pop-up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to Use the search engines. A few topics would be given to the students for which they need to search On Google. This should be demonstrated to the instructors by the student.

MS WORD

Task 1: Creating project abstract Features to be covered: -Formatting Styles, Inserting table, Bullets And Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 2: Creating a Newsletter: Features to be covered: - Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool; give the details of the four tasks and features that would be covered in Each. Using Excel – Accessing, overview of toolbars, saving excel files, using help and resources. **Task 1:** Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, and auto Fill, Formatting Text**.**

Task 2: Calculating GPA -. Features to be covered: - Cell Referencing, Formulae in excel – Average, std. deviation, Charts, Renaming and Inserting worksheets, hyper linking, Count Function

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.**Cos-CO3**

AI TOOLS – Chat GPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model Responds. Try asking questions, starting conversations, or even providing incomplete sentences to See how the model completes them. Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to

Brainstorm creative ideas Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Explore – GITHUB

Task 1: Students should understand GITHUB and should possess accounts in it.

Task 2: Students should explore different repositories available in GITHUB and student should Create his/ her own simple repositories.

Task 3: Students should take simple experiments /presentations and upload them in their GITHUB Account.

Task 4: Students should understand how GITHUB Enterprise Cloud is used and also explore the GIT and GIT HUB resources.

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
6. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition
7. "Microsoft Word 2021: A Beginner’s Guide"by Steve Lambert.
8. "Excel 2021: A Comprehensive Guide"by Chris Benham.
9. "Microsoft PowerPoint 2021: A Beginner’s Guide" by Steve Lambert
10. GITHUB Quick Start Tutorials

Engineering Mechanics Lab
I B.TECH- II SEMESTER

Course Title: Engineering Mechanics Lab	Course Code: R24MEPC02
Teaching Scheme (L:T:P): 0:0:3	Credits: 1.5
Type of Course: Practical	Total Contact Periods:3
Continuous Internal Evaluation:30 Marks	Semester End Exam: 70 Marks
Pre requisites: Physics, Basic Mechanics, Mathematics, Statics, Dynamics.	

COURSE OVERVIEW:

- The Engineering Mechanics Lab is designed to build foundational skills in analyzing forces, equilibrium, and motion, crucial for various engineering applications. The 12 experiments cover essential concepts such as the laws of forces (parallelogram, triangle, and polygon laws), equilibrium conditions for different force systems, and the behavior of friction in static and rolling scenarios. Students also explore gravitational acceleration, moment of inertia, and the mechanical advantage of systems like pulleys and screw jacks. Each experiment emphasizes real-world applications, allowing students to practically verify theoretical principles and analyze system behaviors, preparing them for complex problem-solving in engineering.

COURSE OBJECTIVES:

The objectives of this course are to

- Verify the Law of Parallelogram and Triangle of Forces.
- Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
- Analyze the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel, Screw jack.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Evaluate the coefficientof friction between twodifferent surfaces and between the inclined plane and the roller and study the mechanical characterization.
CO2	Verify Law of Polygonof forces and Law of Moment using force polygon and bell crank
CO3	Determine the Centre of gravity and Moment ofInertia of different configurations.

COURSE CONTENT (SYLLABUS)

LIST OF EXPERIMENTS

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions

5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non-concurrent, parallel force system with the help of a simply supported beam
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum
9. Determine the Moment of Inertia of a Flywheel.
10. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.
11. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency.
12. Develop a mini project on above experimental knowledge.

TEXT BOOKS:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Bavakatti S. S "Engineering Mechanics Statics",4th Edition, New Age International Publications,2012

REFERENCE BOOKS:

1. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022
2. Kurmi R.S.,"Engineering Mechanics Statics",10th Edition, S.Chand Publications,2005

ONLINE RESOURCES:

1. https://www.youtube.com/playlist?list=PLCGTVPoYH6Rbj2Ye38lQgUKACNMMem-wA
2. https://www.youtube.com/watch?v=GgWqsKwPtJs
3. https://www.youtube.com/watch?v=qb_u8OylKuE

NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE
I B.TECH- II SEMESTER (Common to All Branches)

Course Title: NSS/NCC/SCOUTS & Guides/Community Service	Course Code: R24MC02
Teaching Scheme (L:T:P): 0:0:1	Credits: 0.5
Type of Course: Practical	Total Contact Periods:1
Continuous Internal Evaluation: 100	Semester End Exam: 0
Pre requisites: Basic Social Awareness, Discipline and Responsibility, Teamwork and Communication Skills,	

COURSE OVERVIEW:

- This subject NSS/NCC/SCOUTS & Guides/Community Service focuses on fostering a sense of community service, environmental responsibility, and personal development among students. The curriculum encourages students to actively participate in activities that broaden their social awareness, build teamwork skills, and nurture empathy for social and environmental causes.

COURSE OBJECTIVES:

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the importance of discipline, character and service motto.
CO2	Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3	Explore human relationships by analyzing social problems.
CO4	Determine to extend their help for the fellow beings and downtrodden people
CO5	Develop leadership skills and civic responsibilities.

COURSE CONTENT (SYLLABUS)

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities:

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., ―Introduction to Environmental Engineering, McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. ―Introduction to Environmental Engineering and Science‖, Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech-Mechanical Engineering **Regulation**-R24

II Year I Semester-Course Structure

S.No	Category	Course Code	Course Title	Hours per Week			
				L	T	P	Credits
1	BS	R24MEBS09	Numerical Methods and Transform Techniques	3	0	0	3
2	ES	R24MEES09	Thermodynamics	2	0	0	2
3	PC	R24MEPC03	CAD/CAM	3	0	0	3
4	PC	R24MEPC04	Mechanics of Solids	3	0	0	3
5	PC	R24MEPC05	Material Science & Metallurgy	3	0	0	3
6	PC	R24MEPC06	Mechanics of Solids and Materials Science Lab	0	0	3	1.5
7	PC	R24MEPC07	Computer Aided Modeling Lab	0	0	3	1.5
8	SC	R24MESC02	Soft Skills & Verbal Ability	0	1	2	2
9	HS	R24HS06	Design Thinking & Innovation	0	1	2	2
10	MC	R24MC04	Indian Traditional Knowledge	2	0	0	-
Total				**16**	**02**	**10**	**21**

Category	Courses	Credits
BS-Basic Sciences Course	1	3
ES-Engineering Sciences	1	2
PC-Professional Core Courses	5	12
SC-Skill Enhancement course	1	2
HS-Humanities and Management Sciences Courses	1	2
MC-Mandatory Course	1	0
Total	**10**	**21**

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech-Mechanical Engineering **Regulation**-R24

II Year II Semester-Course Structure

S.No	Category	Course Code	Course Title	Hours per Week			
				L	T	P	Credits
1	BS	R24MEBS10	Complex Variables and Statistical Methods	3	0	0	3
2	HS	R24HS03	Universal Human Values- Understanding Harmony and Ethical Human Conduct	2	0	0	2
3	PC	R24MEPC08	Manufacturing Process	3	0	0	3
4	PC	R24MEPC09	Fluid Mechanics & Hydraulic Machines	3	0	0	3
5	PC	R24MEPC10	Industrial Management	3	0	0	3
6	PC	R24MEPC11	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
7	PC	R24MEPC12	Manufacturing Process Lab	0	0	3	1.5
8	SC	R24MESC01	Python Programming Lab	0	1	2	2
9	HS	R24HS04	Quantitative Aptitude & Logical Reasoning	0	1	2	2
10	MC	R24MC03	Environmental Science	2	0	0	-
Total				**16**	**02**	**10**	**21**
Summer internship 2 months (Mandatory) after second year (to be evaluated during III year I Semester) (community service project)							

Category	Courses	Credits
BS-Basic Sciences Course	1	3
HS-Humanities and Management Sciences Courses	2	4
PC-Professional Core Courses	5	12
SC-Skill Enhancement Course	1	2
MC-Mandatory course	1	0
Total	**10**	**21**

NUMERICAL METHODS AND TRANSFORM TECHNIQUES

Course Title: NUMERICAL METHODS AND TRANSFORM TECHNIQUES	**Course Code: R24MEBS09**
Teaching Scheme (L: T:P): 3:0:0	**Credits:3**
Types Of Course: LECTURE	
Continuous Internal Evaluation: 30 MARKS	**Semester End Exam:70 MARKS**

Pre requisites:

- **Algebra and Functions:**
  - Proficiency in solving algebraic equations and understanding function behaviors.
  - Familiarity with concepts like roots of equations and function continuity.
- **Calculus:**
  - Understanding of limits, derivatives, and Taylor series expansions.
  - Ability to analyze function behavior using derivatives.
- **Numerical Methods Basics:**
  - Introduction to numerical approximation techniques.
  - Awareness of error analysis and convergence criteria.

Course Objectives:

1. To elucidate the different numerical methods to solve nonlinear algebraic equations.
2. To disseminate the use of different numerical techniques for carrying out numerical integration.
3. To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

COURSE OUTCOME	PO1	PO2	PO12	BTLEVEL
Evaluate the approximate roots of polynomials and transcendental equations by different algorithms. Apply Newton's forward and backward interpolation and Lagrange's formulae for equal and unequal intervals.	2	2	1	L1,L2,L3
Apply numerical integral techniques to different Engineering problems. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations.	2	2	1	L1,L2,L3
Apply the knowledge of Laplace transforms to solve differential equations.	2	2	1	L1,L2,L3
Compute the Fourier series of periodic signals.	2	2	1	L3,L4
Know and be able to apply integral expressions for the forward and inverse Fourier transforms to a range of non-periodic wave forms.	2	2	1	L4,L5

SYLLABUS

UNIT- I: Iterative Methods

Introduction- Solution of algebraic and transcendental equations: Bisection Method-Secant method-Method of false position-Iteration method –Newton-Raphson method.
Interpolation: Newton's forward and backward formulae for interpolation-interpolation with unequal intervals-Lagrange's interpolation formula.
Self-Learning Topic: Gauss's forward and backward interpolation formula

UNIT- II: Numerical Integration, Solution of ordinary differential equation with initial conditions
Trapezoidal rule-Simson's 1/3rd and 3/8th rule-Solution of initial value problems by Taylor's series-Picard's method of successive approximations-Euler's method – Runge-Kutta method (second and fourth order). **Cos-CO2**
Self-Learning Topic: Milne's Predictor and Corrector Method

UNIT- III: Laplace Transforms

Definition of Laplace transform-Laplace transform of standard functions- Properties of Laplace Transforms-Shifting Theorems-Transforms of derivatives and integrals-Unit step function-Dirac's delta function-Inverse Laplace Transforms-Convolution theorem (without proof)

Applications: Solving ordinary differential equations (initial value problems) and integral differential equation using Laplace transforms.

Self-Learning Topic: Solution of simultaneous differential equations by Laplace transforms.

UNIT- IV: Fourier series

Introduction- Periodic functions- Fourier series of periodic functions-Dirchlet's conditions –Even and odd functions- Change of intervals-Half-range sine and cosine series. Self-Learning Topic: Applications of Fourier series

UNIT- V: Fourier Transforms
Fourier integrals theorems (without proof)-Fourier sine and cosine integrals-Infinite Fourier transforms-Sine and cosine transforms-Properties-Inverse transforms-Convolution theorem (without proof)-Finite Fourier transforms- Parseval's identity for Fourier transforms(without proof).

Self-Learning Topic: Solve Partial differential equation by Fourier transform.

Textbooks:
1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017, 44th Edition
2. B.V.Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018, 10th Edition.
2. M.K.Jain,S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Compuation, New Age International Publication

THERMODYNAMICS

Course Title: THERMODYNAMICS	**Course Code:R24MEES09**
Teaching Scheme:(L:T:P):2:0:0	**Credits:3**
Type of Course: LECTURE	
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: To succeed in Thermodynamics, students should have a basic knowledge of calculus, physics, heat and temperature concepts, and the laws of energy conservation. This foundation will support effective learning and application of thermodynamic principles in mechanical engineering systems.	

Course Objectives:

- Understand the basic thermodynamic terms, types of systems, and governing rules for conversion of one form to other.
- Explain relationships between properties of matter and basic laws of thermodynamics
- Apply the second laws of thermodynamics to various systems and understand the concept of entropy.
- Interpret steam tables and Mollier charts; evaluate the performance of air standard cycles like Otto, Diesel and Dual.
- Describe the working of refrigeration and air conditioning systems and evaluate their performance using psychometric principles.

CourseCode	Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO11	PSO1	PSO2	PSO2	BTL
R24ES09.1	Understand the basic thermodynamic terms, types of systems, and governing rules for conversion of one form to other.	3	2		-	2	1	1	1	-		L1
R24 ES09.2	Explain relationships between properties of matter and basic laws of Thermodynamics.	3	3		-	2	-	1	2	-	1	L2
R24 ES09.3	Apply the second laws of thermodynamics to various systems and understand the concept of entropy.	3	3		2	2		2	3	2	2	L3
R24 ES09.4	Interpret steam tables and Mollier charts; evaluate the performance of air standard cycles like Otto, Diesel, and Dual.	3	2	2	-	2	-	2	3	2	3	L4
R24 ES09.5	Describe the working of refrigeration and air conditioning systems and Evaluate their performance using psychrometric principles.	2	2		-	3	2	2	3	2	2	L2

Unit-I

Fundamentals and Laws of Thermodynamics: Basic concepts: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility

Unit-II

Energy in State and in Transition: Types, Work and Heat, Point and Path function. Zeroeth Law of Thermodynamics – PMM-I, Joule's Experiment

First law of Thermodynamics: applications, Limitations of the First Law, Enthalpy, Internal Energy, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

Unit-III

Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality

Entropy: Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations–Elementary Treatment of the Third Law of Thermodynamics.

Unit-IV

Properties of steam: Pure Substances, P-V-T-surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations --Triple point at critical state properties during change of phase, Dryness Fraction

Air Standard Cycles: Otto, Diesel, Dual combustion cycles; Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air Standard basis-comparison of Cycles.

Unit–V

Introduction to Refrigeration: working of Air, Vapour compression, VCR system Components, COP Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & processes–characterization of sensible and latent heat loads – load concepts of SHF.

Requirements of human comfort and concept of effective temperature-comfort chart–comfort air conditioning and load calculations.

Text Books:

1. P.K.Nag, Engineering Thermodynamics,5/e,TataMcGrawHill,2013.
2. ClausBorgnakkeRichard E.Sonntag,Fundamentals of Thermodynamics,7/e,Wiley,2009.

Reference Books

1. J.B.Jones,andR.E.Dugan,EngineeringThermodynamics,1/e,PrenticeHall,1995.
2. Y.A.Cengel&M.A.Boles,Thermodynamics–AnEngineeringApproach,7/e,McGrawHill,2010.
3. P.Chattopadhyay,EngineeringThermodynamics,1/e,OxfordUniversityPress,2011.
4. CPArora,RefrigerationandAir-conditioning,4/e,McGrawHill,2021.

Online Learning Resources:

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310.
- https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
- https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rd-Semester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_Abhijit-Samant.pdf
- https://www.coursera.org/learn/thermodynamics-intro

CAD/CAM

Course Title: CAD/CAM	Course Code: R24MEPC03
Teaching Scheme (L: T:P): 3:0:0	Credits: 3
Type of Course: LECTURE	
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: As a pre-requisite. Understanding of mechanical/industrial/manufacturing engineering concepts. Knowledge of machine tools, materials, and manufacturing processes. Exposure to software like AutoCAD, Solid Works, CATIA, or Fusion 360.Programming Basics (for CAM/NC programming): Familiarity with G-code/M-code is often needed. Some understanding of logic/programming can be helpful (e.g., Python or MATLAB).	

Course Objectives:

1. To understand the role of computers in industrial manufacturing and the basics of computer hardware, input/output devices, and computer graphics used in design documentation.
2. To learn the fundamentals of geometric modeling and gain hands-on knowledge of drafting and modeling systems for 2D and 3D design.
3. To understand the structure and working of CNC machine tools and develop skills in manual and computer-aided part programming.
4. To explore the concept of Group Technology, part classification, and computer-aided process planning for improving manufacturing productivity.
5. Understand the key terminologies and principles used in quality control and differentiate between contact and non-contact inspection methods

COURSE OUTCOME	PO1	PO2	PO 3	PO5	PO11	PSO1	BTLEVEL
To understand the role of computers in manufacturing and hardware components.	3	-	-	2	-	2	L1,L2
To apply computer graphics and geometric modeling in design and drafting.	-	2	2	3	2	-	L2,L3, L4
To develop NC/CNC part programs using manual and computer-aided methods.	2	-	2	3	-	-	L3,L4, L5
To analyze group technology, process planning.	-	3	3	-	2	2	L2,L4, L5
To learn the overall configuration and elements of computer integrated manufacturing systems.	2	-	3	-	3	3	L2,L3, L5

SYLLABUS

UNIT1: Introduction
Computers in industrial manufacturing, product cycle, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices., clipping, hidden surface removal.

UNIT 2: GEOMETRICMODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modelling facilities desired.

DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modelling.

UNIT 3: PART PROGRAMMING FOR NC MACHINES:NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, Numerical control codes**,** manual part programming methods, Computer Aided Part Programming. Direct Numerical Control, Automatic tool changers, Adaptive Control.

UNIT 4: GROUP TECHNOLOGY: Part family, coding and classification, production flow analysis, types and advantages. Computer aided processes planning – importance, types.Machine cell design, Advantages of GT

UNIT 5: COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labour in manufacturing systems, CIMS benefits

COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods-contact and non-contact types, computer aided testing, integration of CAQC with CAD/CAM.

Text Books:

1. Mikell P-Grover, Emory W. Zimmers, Jr., CAD/CAM –5th Edition 2008.
2. Ibrahim Zeid - CAD/CAM Theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2nd Edition, 1992.
3. Michael E. Mortenson, Geometric modeling, Industrial Press, 3rd Edition, 2006. 4. Koren, Computer Control of Manufacturing Systems, Tata McGraw-Hill Education, 2nd Edition, 2005.

References:

1. P.N Rao, CAD/CAM Principles & Applications, TMH, 2nd Edition, 2008.
2. Chennakesava R. Alavala, CAD/CAM: Concepts and Applications, PHI Learning Pvt. Ltd., 2nd Printing, 2008.
3. David F. Rogers, Mathematical Elements for Computer Graphics, McGraw-Hill, 2nd Edition, 1990.
4. Tien-Chien Chang, Richard A. Wysk, Hsu-Pin Wang, Computer-Aided Manufacturing, Pearson Prentice Hall, 3rd Edition, 2006.

MECHANICS OF SOLIDS

Course Title: MECHANICS OF SOLIDS	**Course Code: R24MEPC04**
Teaching Scheme (L: T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	
Continuous Internal Evaluation: 30 Marks	**Semester End Exam: 70 Marks**
Pre requisites: The prerequisites for studying Mechanics of Solids, also known as Strength of Materials, typically include a foundational understanding of engineering mechanics and mathematics. This subject is essential for students pursuing degrees in civil, mechanical, and structural engineering, as it provides the tools to analyze and design structural components subjected to various loads.	

Course Objectives:

1. To find the stresses & deformations of a member due to axial loading under uniform and non-uniform conditions.
2. To interpret the variation of SF&BM indeterminate beam.
3. To analyze the structural members subjected to bending stress and shear loads.
4. To identify the slope and deflection for different support arrangements by different methods and shear stresses induced in circular shafts.
5. To analyze the stresses induced in thin and thick cylinders subjected to internal and external pressures and analyze the columns in stability point of view with different end conditions.

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Find the stresses & deformations of a member due to axial loading under uniform and non- uniform conditions.	3	2	3	1	3	3	L1, L2
Interpret the variation of SF&BM indeterminate beams	3	3	3	2	2	3	L1,L2, L3,
Analyze the structural members subjected to bending stress and shear loads.	3	2	3	3	2	3	L1,L2,
Identify the slope and deflection for different support arrangements by different methods and shear stresses induced in circular shafts	3	2	3	3	3	3	L1,L2,
Analyze the stresses induced in thin and thick cylinders subjected to internal and external pressures.	3	2	2	2	3	2	L1,L2,L3,

SYLLABUS

UNIT –I

SIMPLE STRESSES &STRAINS : Elasticity and plasticity– Types of stresses &strains–Hooke's law –stress– strain diagram for mild steel –Working stress – Factor of safety– Lateral strain, Poisson's ratio and volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uni axial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

Applications: Marine, Aerospace, Automotive, and Civil Engineering structural components

UNIT –II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

Applications: Beams, Frames, roof beams and other structural elements **(16hours)**

UNIT –III

FLEXURAL STRESSES: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

Applications: Shafts, Gears, Machine frames, Beams, Girders, and structural members in buildings and bridges; bolts, pins, and fasteners

UNIT –IV

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods –

Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, Statically indeterminate Beams and solution methods.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

Applications: Aircraft wings, Automobile chassis components, Dams, Retaining walls and Power Transmissions Elements

UNIT –V

THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia and volume of thin cylinders – Riveted boiler shells – Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.

COLUMNS:

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula

Applications: Pressure Vessels and Columns and Pillars in buildings

TEXT BOOK:

1. Strength of materials/GHRyder/McMillan publishers India Ltd
2. Mechanics of materials by Gere & Timeshenko

REFERENCES:

1. Strength of Materials –By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani- Khanna Publishers
3. MechanicsofStructuresVol-III, byS.B. Junnarkar-CharotarPublishingHouse
4. Strength of Materials by S. Timshenko-D. VANNOSTRAND Company-PHI Publishers
5. Strength of Materials by Andrew Pytel and FerdinondL.Singer Longman- HarperCollins College Division
6. Solid Mechanics, by Popov.
7. Mechanics of Materials/Gere and Timoshenko, CBS Publishers

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc19_ce18/preview.
- https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6.
- https://www.youtube.com/watch?v=WEy939Rkd_M&t=2s
- https://www.classcentral.com/course/swayam-strength-of-materials-iitm-184204
- https://www.coursera.org/learn/mechanics-1
- https://www.edx.org/learn/engineering/massachusetts-institute-of-technology mechanical-behavior-of-materials-part-1-linear-elastic-behavior
- https://archive.nptel.ac.in/courses/112/107/112107146/

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MATERIAL SCIENCE & METALLURGY

Course Title: MATERIAL SCIENCE & METALLURGY	**Course Code: R24MEPC05**
Teaching Scheme (L: T:P): 3:0:0	**Credits:3**
Types Of Course: LECTURE	
Continuous Internalevaluation:30 MARKS	**Semester End Exam:70 MARKS**
Pre requisites: Manufacturing processes (casting, forming, machining) Engineering drawings and tolerances, Heat treatment processes6. Introductory Materials Knowledge Types of materials (metals, ceramics, polymers, composites) Basic material properties (density, hardness, conductivity) Phase diagrams (especially binary phase diagrams.	

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO7	PSO1	BT LEVEL
Describe and analyze the structure and crystallography of metals.	2	**2**					**L2,L4**
Classify ferrous and non-ferrous metals and identify their properties and applications.	**2**				**2**		**L2**
Explain various heat treatment processes and their impact on material properties.	**3**			**3**			**L2,L3**
Understand and outline the principles and applications of powder metallurgy and ceramics.	**2**	**2**	**2**				**L2**
Identify types of ceramics and explain their processing and applications.	**2**	**2**			**3**		**L2,L3**

Course Objectives:

* Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.
* Study the behavior of ferrous and non-ferrous metals and alloys and their application in different domains.
* Understand the effect of heat treatment and the addition of alloying elements on the properties of ferrous metals.
* Grasp the methods of making metal powders and applications of powder metallurgy.
* Comprehend the properties and applications of ceramics, composites, and other advanced materials.

SYLLABUS

UNIT – I: STRUCTURE OF METALS AND CONSTITUTION OF ALLOYS

Crystallization of metals, Packing factor – SC, BCC, FCC & HCP, Line density, plane density, Grain and grain boundaries, effect of grain boundaries – determination of grain size, Imperfections, slip, and twinning, Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds

EQUILIBRIUM DIAGRAM: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring, miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction, Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, Relationship between equilibrium diagrams and properties of alloys, Study of binary phase diagrams such as Cu-Ni and Fe-Fe_3C

UNIT – II: FERROUS AND NON-FERROUS METALS AND ALLOYS

Ferrous Metals and Alloys: Structure and properties of: White Cast Iron, Malleable Cast Iron, Grey Cast Iron, Spheroidal Graphite Cast Iron, Alloy Cast Iron, Plain Carbon Steels, Low Alloy Steels, Hadfield Manganese Steels, Tool, and Die Steels,

NON-FERROUS METALS AND ALLOYS: Structure and properties of: Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Superalloys

UNIT – III: HEAT TREATMENT OF STEELS

Effect of alloying elements on Fe-Fe_3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, Surface-hardening methods, age-hardening treatment, Cryogenic treatment

UNIT – IV: POWDER METALLURGY

POWDER METALLURGY: Basic processes – Methods of producing metal powders: milling, atomization, granulation, reduction, electrolytic deposition, Compacting methods, sintering, and methods of manufacturing sintered parts, Secondary operations, Applications of powder metallurgical products, **additive manufacturing via powder metallurgy (SLS, EBM, Binder jetting).**

UNIT-V: CERAMICS: Classification and properties of ceramics: Crystalline ceramics, glasses, cermet's, abrasive materials, Advanced ceramics: Electrical, magnetic, optical applications, Manufacturing methods for ceramics, Composites: Classification (PMC, MMC, CMC, CCC), structure, properties and applications

Text Books:

1. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw-Hill, 1997.
2. Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018.

REFERENCE BOOKS:

1. Dr. V.D.kodgire, Material Science and Metallurgy, 39/e, Everest Publishing House, 2017.
2. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
3. William D. Callister Jr. Materials Science and Engineering: An Introduction, 8/e, John Wiley and Sons, 2009,
4. George Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
6. AVK Suryanarayana, Material Science and Metallurgy, B S Publications, 2014.
7. U. C. Jindal, Material Science and Metallurgy, 1/e, Pearson Publications, 2011.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/113/106/113106032/
2. https://www.edx.org/learn/mechanics/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-3-time-dependent-behavior.
3. https://www.youtube.com/watch?v=9Sf278j1GTU
4. https://www.coursera.org/learn/fundamentals-of-materials-science
5. https://www.coursera.org/learn/material-behavior.

MECHANICS OF SOLIDS AND MATERIALS SCIENCE LAB

Course Title: MECHANICS OF SOLIDS AND MATERIALS SCIENCE LAB	**Course Code: R24MEPC06**
Teaching Scheme (L: T:P): 0:0:3	**Credits: 1.5**
Type of Course: PRACTICAL	
Continuous Internal Evaluation: 30 Marks	**Semester End Exam: 70 Marks**
Pre requisites: To suck seed in Mechanics of solids lab and students should have basic knowledge in Stresses and strains, torsion, bending, axial loading etc which are tested experimentally in the lab along with the structure and mechanical properties of materials	

Course Objectives:

1. To familiarize the students on conducting various destructive tests for determining the strength of various materials under externally applied loads from the theoretical knowledge gained from Mechanics of Solids.
2. To familiarize the students on Material properties and their structures.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT LEVEL**
Understand the stress strain behavior of different materials.	3	1	1	-	-	1	L1, L2
Evaluate the hardness of different materials.	3	1	2	2	-	2	L1, L2, L3
Explain the relation between elastic constants and hardness of materials.	3	2	3	2	3	3	L1, L2
Identify various micro structures of steels and cast irons.	3	-	3	3	3	2	L1, L2
Evaluate hardness of treated and untreated steels.	3	-	-	2	3	2	L1, L2, L3

SYLLABUS

Cycle I:List of Experiments: Mechanics of Solids Lab

1. Tension test and Compression test on Springs
2. Rockwell &Brinell hardness test of materials.
3. Izod&Charpy impact tests.
4. Deflection test on Cantilever and Simply Supported beams.
5. Tensile test on Mild steel rod.

6. Compression test on Wooden cube.
7. Torsion test on Mild Steel bar.

Cycle II : List of Experiments: Materials Science Lab

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high– Carbon steels.
3. Study of the Micro Structures of Cast Irons.
4. Study of the Micro Structures of Non-Ferrous alloys.
5. Study of the Micro structures of Heat-treated steels.
6. Hardenability of steels by Jominy End Quench Test.
7. To find out the hardness of various treated and untreated steels

References/Manuals/Software:

1. Text Book: Solid Mechanics by Kazimi.S.M.A, second revised Edition, Tata McGraw Hill Publishing Company Limited
2. Lab Manual

COMPUTER AIDED MODELLING LAB

Course title: COMPUTER AIDED MODELLING LAB	Course Code: R24MEPC07
Teaching Scheme (L: T:P): 0:0:3	Credits:1.5
Type of Course: PRACTICAL	
Continuous Internal Evaluation: 30Marks	Semester End Exam: 70Marks
Pre requisites: Engineering Drawing- Projections- Orthogonal, Isometric Views	

Course Objectives:

1. To develop skills in 2D drafting
2. To understand and use standard CAD file formats
3. To gain proficiency in surface modeling techniques
4. To learn 3D part modeling techniques
5. To create and visualize mechanical assemblies

COURSE OUTCOME	PO1	PO2	PO3	PO5	P010	P011	PSO1	BT LEVEL
Develop 2D orthographic and isometric drawings with proper dimensioning and tolerance.	3	1	-	3	1	-	2	L1,L2,L3,
Understand and apply surface modeling techniques to generate complex surfaces.	3	2	-	3	2	-	2	L2,L3,L6
Create 3D part models using features like pad, revolve, sweep, shell, and Boolean operations.	3	3	3	3	2	-	3	L2,L3,L6
Perform assembly modeling of mechanical components using 3D software.	3	3	3	3	3	3	2	L2,L3,L6
Gain familiarity with CAD data exchange formats such as DXF and IGES.	2	2	2	3	2	3	2	,L2,L3,L6

List of Experiments:

The following are to be done by any 2D software package

1. **DRAFTING**: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances, Study of DXE, IGES files.
2. **SURFACE MODELING** - Generation of various Surfaces using surface modelling.

The following contents to be done by any 3D software package:

1. **PART MODELING:** Generation of various 3D models through Pad, revolve, shell, sweep, parent child relation, Boolean operations and various standard translators.
   Assembly drawings: (Any four of the following using solid model software)
2. Generation of various Parts/assemblies of Flange Coupling
3. Generation of various Parts/assemblies of Piston and Cylinder
4. Generation of various Parts/assemblies of Foot step bearing
5. Generation of various Parts/assemblies of Oldham's Coupling
6. Generation of various Parts/assemblies of Universal Coupling
7. Generation of various Parts/assemblies of Muff coupling
8. Generation of various Parts/assemblies of knuckle joint
9. Generation of various Parts/assemblies of cotter joint
10. Generation of various Parts/assemblies of Crankshaft
11. Generation of various Parts/assemblies of Connecting Rod
12. Generation of various Parts/assemblies of Screw Jack

Textbooks:

1. **"CAD/CAM: Computer Aided Design and Manufacturing** *"by Mikel P. Groover and Emory W.Zimmers.*

Reference Books:

1.**"CATIA V5 Workbook"***by Richard Cozzens*

SOFT SKILLS& VERBAL ABILITY

Course Title: SOFT SKILLS& VERBAL ABILITY	**Course Code:R24MESC02**
Teaching Scheme (L: T:P): 0:1:2	**Credits:02**
Type of Course: Tutorials + Practical's	
ContinuousInternalEvaluation:30 Marks	**Semester End Exam:70Marks**
Prerequisites: To succeed in Soft Skills and Verbal ability, students should have a basic understanding of effective communication principles, including verbal and non-verbal communication. Familiarity with teamwork and collaboration techniques is essential for group activities and presentations. A positive attitude and willingness to receive feedback help in personal development. Time management and problem-solving abilities support efficient task handling. Basic proficiency in English and presentation tools also enhances overall performance in soft skills training	

Course objective:

1. Enhance proficiency in English grammar, vocabulary, and reasoning skills for recruitment exams.
2. Develop effective communication skills for group discussions, resume building, and interviews.
3. Equip students with techniques for reading comprehension, logical reasoning, and professional presentation.
4. Prepare students for successful career placements through improved language and soft skills.

Course Outcomes:
At the end of this course the student will be able to

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO8	PO9	PO10	PO11	BT LEVEL
CO1: Demonstrate strong command over English grammar, vocabulary and reasoning skills	3	3	2	2	1	1	1	1	2	1	L3
CO2: Effectively communicate in group discussions, create impactful resumes and excel in interviews	2	1	1	1	2	2	2	3	3	2	L4
CO3: Develop critical thinking and problem-solving abilities for Recruitment exams	3	3	2	2	1	1	1	1	2	1	L3
CO4: Be well- prepared for career placements with enhanced professional communication and Soft skills	2	2	1	1	2	2	2	3	3	2	L3

Unit I – English Grammar and Usage (10 Hours)

***This unit focuses on core grammar concepts frequently tested in company recruitment exams. Topics include*:**

Parts of Speech, Tenses and Subject-Verb Agreement, Articles and Prepositions, Sentence Correction and Spotting Errors, Active and Passive Voice, Direct and Indirect Speech

Learning Outcome: Students will demonstrate accurate grammar usage and error detection skills in various sentence structures.

Vocabulary Development and Application (10 Hours)
This unit enhances vocabulary required for business communication and aptitude tests. Topics include:

Synonyms and Antonyms, One-word Substitution, Idioms and Phrases, Confusing Word Pairs, Phrasal Verbs and Collocations

Learning Outcome: Students will improve their vocabulary strength and apply words appropriately in verbal and written contexts.

Unit II – Reading Comprehension Skills (5 Hours)
Students will learn techniques to understand, interpret, and analyze passages. Focus areas:

Main Idea and Supporting Details, Inference-Based Questions, Vocabulary in Context, Tone and Author's Perspective

Learning Outcome: Students will effectively comprehend and answer questions based on unseen passages within time constraints.

Verbal Reasoning and Logic-Based Language Skills (5 Hours)
This unit covers logical verbal questions commonly seen in recruitment exams:

Sentence Completion, Cloze Tests, Para Jumbles / Sentence Rearrangement, Statement and Conclusion / Assumptions.

Learning Outcome: Students will develop reasoning skills to solve pattern-based language puzzles.

Unit III – Group Discussion Skills (10 Hours):

This unit develops students' ability to communicate effectively in a group setting. It includes understanding the GD format, evaluation criteria, and participation strategies. Sessions will train students on body language, tone modulation, handling abstract and controversial topics, and presenting logical arguments. Multiple GD simulations will be conducted with personalized feedback to improve spontaneity and structure in speaking.

Learning Outcome: students will be able to communicate their ideas clearly, listen actively, contribute effectively to discussions, and demonstrate leadership and teamwork while maintaining professionalism and respect for diverse opinions.

Unit IV – Resume Preparation and Personal Branding (10 Hours):

This unit guides students in preparing an impactful, professional resume suited for technology and consulting sectors. Key areas include formatting, project and internship presentation, using effective language, and highlighting strengths and certifications. Students will also learn to optimize their LinkedIn profiles and online presence to reflect a professional digital identity.

Learning Outcome: Students will be able to create a professional, well-structured resume that highlights their skills and experiences, and build a strong personal brand to effectively present them in the job market

Unit V – Interview Preparation (10 Hours):

This unit addresses all aspects of interview readiness. It covers commonly asked HR and technical questions, behavioral questions using the STAR (Situation, Task, Action, Result) method, and communication strategies during online interviews. Students will receive training in grooming, attire, voice modulation, and confidence building

Learning Outcome: students will be able to confidently handle both technical and HR interviews, presenting themselves professionally and effectively communicating their skills and experiences

Text Books:

1. **Wren, P. C., and H. Martin,***High School English Grammar and Composition,* S. Chand Publishing, 1990.
2. **Lewis, N.,***Word Power Made Easy,*Goyal Publishers, 1993.
3. **Aggarwal, R. S.,***A Modern Approach to Verbal & Non-Verbal Reasoning,* S. Chand Publishing, 2017.
4. **Bakshi, S. P.,***Objective General English,*Arihant Publications, 2018.

E-Resources :

1. **Grammarly,***AI-powered writing assistant,*Grammarly, https://www.grammarly.com/
2. **IndiaBIX,***Online Aptitude & Reasoning Practice,*IndiaBIX, https://www.indiabix.com/.
3. **AmbitionBox,***Interview Experiences and Reviews,*AmbitionBox, https://www.ambitionbox.com/.
4. **Canva,***Online Resume Builder and Templates,*Canva, https://www.canva.com/resumes/templates
5. **Testbook,***Testbook: Online Mock Tests and Practice Papers,*https://testbook.com/.

DESIGN THINKING & INNOVATION

Course Title: DESIGN THINKING & INNOVATION	Course Code: R24HS06
Teaching Scheme (L: T:P): 0:1:2	Credits: 02
Type of Course: Tutorials+ Practical's	
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Pre requisites: To succeed in Design Thinking & Innovation, students should have a basic understanding of problem-solving methodologies and critical thinking. Familiarity with user experience (UX) principles and empathy mapping is essential for understanding user needs. Knowledge of brainstorming techniques and collaborative tools aids in effective ideation. Basic skills in prototyping and rapid iteration are important for resting and refining solutions. Additionally, an understanding of business strategy and market research supports the creation of viable and innovative solutions	

Course Objectives

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems

Course Outcomes:

After completing the course, the student should be able to

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	BT LEVEL
CO1: Define the concepts related to design thinking.	2	1			2	1			L1,L2
CO2: Explain the fundamentals of Design Thinking and innovation.	2	2	1		2	2			L1,L2
CO3: Apply the design thinking techniques for solving problems in various sectors	3	3	2	2	3	2	2		L3
CO4: Analyse to work in a multidisciplinary environment.	3	3	3	2	3	3	3		L4
CO5: Evaluate the value of creativity	3	3	3	3	3	3			L5
CO6: Formulate specific problem statements of real-time issues.	3	3	3	3	3	3	3		L3,L6

UNIT I Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design.Introduction to design thinking, history of Design Thinking, New materials in Industry. -CO1,CO2

UNIT II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking person, costumer, journey map, brainstorming, product development-CO2,CO3,CO6

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT III Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations-Creativity to Innovation-Teams for innovation-Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation. -CO2,CO3,CO5

UNIT IV Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design-Case studies-CO3,CO4,CO6

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business - Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs-Design thinking for Startups- Defining and testing Business Models and Business Cases-Developing & testing prototypes. - CO3,CO4,CO5,CO6

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, Harper Bollins (2009)
2. IdrisMootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Online Learning Resources:

https://nptel.ac.in/courses/110/106/110106124/
https://nptel.ac.in/courses/109/104/109104109/

Course Title: Indian Traditional Knowledge	**Course Code: R24MC04**
Teaching Scheme (L:T:P):2:0:0	**Credits:-**
Type of Course: Lecture	
Continuous Internal Evaluation: 30 Marks	**Semester End Exam:**70Marks
Prerequisites: To succeed in Indian Traditional Knowledge, students should have a basic understanding of cultural heritage, environmental sustainability and indigenous practices. Familiarity with legal and constitutional frameworks, especially related to biodiversity and forest rights, is essential.	

Course Objectives:

To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system

- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system.
- To understand the legal frame work and traditional knowledge and biological diversity act 2002 and geographical indication act 2003.
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection.
- To know the student traditional knowledge in different sector.

Course Outcomes:

After completion of the course, students will be able to:

CourseOutcomes	PO1	PO2	PO6	PO7	PO8	PSO1	BT LEVEL
CO1:Understand the concept of Traditional knowledge and its importance	2	0	2	2	2		L2
CO2:Know the need and importance of protecting traditional knowledge	2	2	3	2	3		L2
CO3:Know the various enactments related to the protection of traditional knowledge	2	2	3	2	3		L1
CO4:Understand the concepts of Intellectual property to protect traditional knowledge	3	2	2	2	2		L2

UNIT-I

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kind so traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge. **COs- CO1**

UNIT-II

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK. **COs- CO1,CO2**

UNIT-III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003. **COs- CO2,CO3**

UNIT-IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, certain non IPR mechanism so traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge. **COs- CO3,CO4**

UNIT-V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and health care needs, Importance of conservation and sustainable development of environment, Managementof biodiversity, Food security of the country and protection of TK. **COs- CO3,CO4**

Reference Books:

1. Traditional Knowledge System in India, by AmitJha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Traditional Knowledge System in India by AmitJha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

e-Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

COMPLEX VARIABLES AND STATISTICAL METHODS

Course Title: COMPLEX VARIABLES AND STATISTICAL METHODS	**Course Code:R24MEBS10**
Teaching Scheme (L: T: P):3:0:0	**Credits:3**
Type of Course: LECTURE	
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: As a pre-requisite to this course students are required to have a reasonable mastery over multivariable calculus, differential equations, and Linear algebra.	

Course Objectives:

1. To familiarize the complex variables.
2. To familiarize the students with the foundations of probability and statistical methods.
3. To equip the students to solve application problems in their disciplines.

At the end of the course student will be able to:

Course Outcomes	PO1	PO2	PO12	BT LEVEL
To obtain an analytic function for a given harmonic function using C-R equations.	2	2	1	L1, L2
Make use of the Cauchy residue theorem to evaluate certain integrals.	2	2	1	L1,L2
Apply the theoretical probability distributions like Binomial, Poisson, and normal in the relevant application areas.	2	2	1	L1,L2, L3
Analyze to test various hypotheses included in theory and types of errors for large samples.	2	2	1	L4
Apply the different testing tools like t-test, F-test, chi-square test to analyze the relevant real-life problems.	2	2	1	L4,L5

SYLLABUS

UNIT- I: Functions of a complex variable and Complex integration

Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates –Harmonic and conjugate harmonic functions – Milne –Thompson method. Complex integration: Line integral– Cauchy's integral theorem–Cauchy's integral formula

Self- learning Topics: Evaluating contour integrals, Integration along a smooth path

UNIT- II: Series expansions and Residue Theorem

Radius of convergence –Expansion in Taylor's series, Maclaurin's series and Laurent series.Types of Singularities:

Isolated –Essential – Pole of order m –Residues–Residue theorem (without proof) and evaluation of real integrals of the form $\int_{-\infty}^{\infty} f(x)\, dx$,

Self- learning Topics: Approximating a function or data using a series of function is a fundamental tool for data analysis.

UNIT- III: Probability and Distributions

Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability Density function and Cumulative distribution functions – Mathematical Expectation and Variance –Binomial, Poisson, Uniform and Normal distributions.

Self -learning Topics: To understand risk and return on investment.

UNIT-IV: Sampling Theory

Introduction –Population and Samples–Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Representation of the normal theory distributions– Introduction to t, χ^2 and F-distributions–Point and Interval estimations –Maximum errorofestimate.

Self- learningTopics: Estimate health outcomes, behaviors and attitudes within a population.

UNIT- V: Tests of Hypothesis

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors –Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples)–Tests on proportions.

Self- learning Topics: Hypothesis Testing is employed to ensure product quality and process efficiency.

Textbooks:

1. **B.S.Grewal,** Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. **Miller and Freund's,** Probability and Statistics for Engineers, Pearson, 7th edition, 2008.

Reference(s):

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

2. Jay l. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.

3. Shron L. Myers, Keying Ye, Ronald E Walpole, Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.

4. Sheldon, M. Ross, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011

Online Learning Resources:

https://archive.nptel.ac.in/courses/111/106/111106141/

https://nptel.ac.in/courses/111105134

UNIVERSAL HUMAN VALUES UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course title: UNIVERSAL HUMAN VALUES UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT	**CourseCode:R24HS03**
Teaching Scheme(L:T:P): 2:0:0	**Credits:2**
Type of Course: LECTURE	
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: To succeed in Universal Human Values: Understanding Harmony and Ethical Human Conduct, you'll need a basic foundation in critical thinking, moral reasoning, and communication skills. Familiarity with fundamental concepts of ethics, basic social sciences, and an openness to introspection and dialogue are also important.	

Course Objectives:

1. To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Course Outcomes:

1. Know the difference between the needs of the body and the self, and how education helps in living a happy and meaningful life
2. Learn how the self and the body work together and how to take care of both through right understanding
3. Understand and practice values like trust, respect, and justice in family and society
4. See how all parts of nature are connected and support each other, and how we fit into this harmony.
5. Use what you learn to live ethically and contribute positively at work and in society

After completing the course, the student should be able to

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	BT LEVEL
CO1: Define terms like Natural Acceptance, Happiness, and Prosperity	1	2	–	–	–	2	3	–	2	–	3		L2,L4
CO2: Identify one's self, and one's surroundings (family, society, nature)	1	2	–	–	–	3	3	2	2	–	3		L2,L3
CO3: Apply what they have learnt to their own self in day-to-day settings	1	2	–	–	–	2	3	2	2	–	3		L4,L5
CO4: Relate human values with human relationships and society	1	2	–	–	–	3	3	3	2	–	3		L4,L5
CO5: Justify the need for universal human values and harmonious existence	2	2	–	–	–	3	3	3	2	–	3	2	L4,L5
CO6: Develop as socially and ecologically responsible engineers	2	2	2	2	2	3	3	2	2	2	3	3	L4,L5

Course Topics

The course has 28 lectures and14tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.
The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I

Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about One self Lecture3:self-exploration as the Process for Value Education

Lecture4: Continuous Happiness and Prosperity–the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial3: Practice Session PS3 Exploring Natural Acceptance

UNIT II

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture7: Understanding Human being as the Co-existence of the self and the body.

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial4:PracticeSessionPS4ExploringthedifferenceofNeedsofselfandbody.

Lecture 9: The body as an Instrument of the self

Lecture10: Understanding Harmony in the self

Tutorial5: Practice Session PS5 Exploring Sources of Imagination in the self

Lecture 11: Harmony of the self with the body

Lecture12: Programme to ensure self-regulation and Health

Tutorial6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III

Harmony in the Family and Society (6lectures and 3 tutorials for practice session)

Lecture13: Harmony in the Family–the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial l7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 15: 'Respect' – as the Right Evaluation

Tutorial8:Practice Session PS8 Exploring the Feeling of Respect

Lecture16:Other Feelings, Justice in Human-to-Human Relationship

Lecture 17: Understanding Harmony in the Society

Lecture18:Vision for the Universal Human Order

Tutorial9:Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture19: Understanding Harmony in the Nature

Lecture20:Inter connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature

Tutorial10:Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture22:The Holistic Perception of Harmony in Existence

Tutorial11:Practice Session PS11 Exploring Co-existence in Existence.

UNIT V

Implications of the Holistic Understanding–a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values
Lecture24:Definitiveness of (Ethical) Human Conduct

Tutorial12:Practice Session PS12 Exploring Ethical Human Conduct

Lecture25:A Basis for Humanistic Education,Humanistic Constitution and Universal Human Order

Lecture26:Competence in Professional Ethics

Tutorial13:Practice Session PS13Exploring Humanistic Models in Education

Lecture27:Holistic Technologies, Production Systems and Management Models Typical Case Studies

Lecture28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for

UNITI–Introduction to Value Education

PS 1Sharing about One self

PS2 Exploring Human Consciousness

PS3 Exploring Natural Acceptance

Practice Sessions for

UNITII–Harmony in the Human Being

PS4 Exploring the difference of Needs of self and body

PS5 Exploring Sources of Imagination in the self

PS6 Exploring Harmony of self with the body

Practice Sessions for

UNIT III –Harmony in the Family and Society

PS7 Exploring the Feeling of Trust

PS8Exploring the Feeling of Respect

PS9Exploring Systems to fulfill Human Goal

Practice Sessions for

UNIT IV–Harmony in the Nature (Existence)

PS10Exploring the Four Orders of Nature

PS11Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12Exploring Ethical Human Conduct

PS13Exploring Humanistic Models in Education

PS14Exploring Steps of Transition towards Universal Human Order

Readings:

Text book and Teachers Manual

1.The Text book

RRGaur,RAsthana,GPBagaria,*AFoundationCourseinHumanValuesandProfessional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,*2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1.JeevanVidya: EkParichay,ANagaraj,JeevanVidyaPrakashan, Amarkantak,1999.

2.Human Values,A.N.Tripathi,NewAgeIntl.Publishers, NewDelhi,2004.

3.The Story of Stuff (Book).

4.The Story of My Experiments withTruth-by Mohand as KaramchandGandhi

5.Smallis Beautiful -E. F Schumacher.

6.Slowis Beautiful-Cecile Andrews

7.Economy of Permanence-JC Kumarappa

8.Bharat Mein AngrejiRaj –PanditSunderlal

9.Rediscovering India- by Dharampal

10.HindSwaraj or Indian Home Rule-by Mohand ask. Gandhi

11.India Wins Freedom-Maulana Abdul Kalam Azad

12.VivekAnanda-Romain Rolland(English)

13.Gandhi-Romain Rolland (English)

Online Resources:

1.https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf

2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf

3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf

4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf

5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf

6. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf

7. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385

8. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

MANUFACTURING PROCESS

Course Title: MANUFACTURING PROCESS	Course Code: R24MEPC08
Teaching Scheme(L:T:P):3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation:30Marks	Semester End Exam:70 Marks

Pre requisites: Fundamentals of material science, including properties and behavior of metals under various conditions. Basic mechanical and thermal engineering concepts, such as stress-strain, heat flow, and deformation. Introductory knowledge of manufacturing processes and machine operations for shaping and joining materials.

Course Objectives:

1. Know the working principle of different metal casting processes and gating system To interpret the variation of SF&BM indeterminate beam.
2. Classify the welding processes, working of different types of welding processes and welding defects
3. Know the nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes
4. Understand the principles of forging, tools and dies, working of forging processes
5. Know about the Additive manufacturing

Course Outcomes	PO1	PO2	PO3	PO4	P012	PS01	BT LEVEL
Know the working principle of different metal casting processes and gating system to interpret the variation of SF&BM indeterminate beam	3	2	3	2	-	2	L1, L2, L3
Classify the welding processes, working of different types of welding processes and welding defects	3	2	3	3	-	2	L2, L3, L4
Know the nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes	3	2	3	3	-	2	L2, L3, L4
Understand the principles of forging, tools and dies, working of forging processes	3	1	3	3	-	2	L2

Know about the Additive manufacturing	3	1	3	3	3	3	L2, L3

SYLLABUS

UNIT –I

Casting: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding, different types of cores, Principles of Gating, Risers, casting design considerations. Methods of melting and types of furnaces, Solidification of castings and casting defects- causes and remedies. Basic principles and applications of special casting processes - Centrifugal casting, Die casting, Investment casting and shell molding.

UNIT–II

Welding: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG& MIG welding. Electro–slag welding.

Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering &Brazing.

Heat affected zones in welding; pre& post heating, welding defects–causes and remedies.

UNIT–III

Bulk Forming: Plastic deformation in metals and alloys-recovery, recrystallization and grain growth.

Hot working and Cold Working-Strain hardening and Annealing. Bulk forming processes: Forging-Types of Forging, forging defects and remedies; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics.Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT–IV

Sheet metal forming-Blanking and piercing, Forces and power requirement in these operations,Deep drawing,stretch forming,Bending, Spring back and its remedies,Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitation.

UNIT-V

Additive manufacturing - Fundamentals of AM, types of materials for AM, Steps in Additive Manufacturing , Classification of AM processes, VAT photopolymerization AM Processes, Extrusion -Based AM Processes, Powder Bed Fusion AM Processes, Direct Energy Deposition AM Processes, Post Processing of AM Parts, Advantages of AM, Applications

TEXT BOOK:

1. Kalpakjain S and Steven R Schmid, Manufacturing ProcessesforEngineering Materials, 5/e, Pearson Publications, 2007.
2. P.N. Rao,Manufacturing Technology-VolI,5/e, McGraw Hill Education,

REFERENCES:

1. A.Ghosh&A.K. Malik, Manufacturing Science,EastWestPressPvt.Ltd,2010.
2. Lindberg and Roy, Processes and materials of manufacture, 4/e, Prentice Hall India Learning Private Limited, 1990.
3. R.K.Jain,Production Technology,Khanna Publishers,2022.
4. Sharma P.C., A Text book of Production Technology,8/e,S Chand Publishing,2014.
5. H.S. Shaun, ManufacturingProcesses,1/e,PearsonPublishers, 2012.
6. WAJ Chapman, Workshop Technology, 5/e, CBS Publishers & Distributors Pvt.Ltd, 2001.
7. Hindustan Machine Tools, Production Technology,Tata McGraw Hill Publishers,2017.
8. Ian Gibson,DavidWRosen,BrentStucker.,Additive Manufacturing Technologies:3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2/e, Springer, 2015.

Online Learning Resources:

- https://www.edx.org/learn/manufacturing/massachusetts-institute-of-technology-fundamentals-of-manufacturing-processes
- https://onlinecourses.nptel.ac.in/noc21_me81/preview
- www.coursera.org/learn/introduction-to-additive-manufacturing-processessera
- https://archive.nptel.ac.in/courses/112/103/112103263/
- https://elearn.nptel.ac.in/shop/nptel/principles-of-metal-forming-technology/?v=c86ee0d9d7ed

FLUID AND MECHANICS AND HYDRAULIC MACHINES

Course title: FLUID AND MECHANICS AND HYDRAULIC MACHINES	**Course code: R24MEPC09**
Teaching scheme (L: T:P): 3:0:0	**Credits:3**
Types of course: LECTURE	
Continuous internal evaluation:30 MARKS	**Semester end exam:70 MARKS**
Pre requisites: Before diving into **Fluid Mechanics and Hydraulic Machines**, it's crucial to have a solid foundation in certain key subjects. Here are the main prerequisites: Understanding differentiation and integration for fluid flow analysis Essential for solving equations related to fluid behaviour. **Differential Equations** – Used in describing fluid motion and continuity equations. **Dimensional Analysis** – Used in scaling fluid mechanics problems. **Instrumentation and Measurements** – Flow meters, pressure gauges, and velocity measurement techniques. **Computational Methods** – Basics of simulation tools like CFD (Computational Fluid Dynamics).	

Course Objectives:

1. **Understand** the properties of fluids and principles of fluid statics and kinematics
2. **Apply** Bernoulli's and momentum equations to analyze practical fluid flow situations.
3. **Analyze** flow through pipes and evaluate jet impact on vanes in fluid machinery.
4. **Evaluate** performance parameters of hydraulic turbines and their components.
5. **Assess** and compare the performance of centrifugal and reciprocating pumps.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO9	PO10	PO11	PSO1	BT LEVEL
Understand the fundamental properties of fluids and apply fluid statics principles to pressure measurement devices.	3	3	2	2	2	-	1	2	2	L1, L2
Analyze different fluid flow types using kinematic and dynamic equations including continuity, Bernoulli's, and momentum equations.	3	3	3	2	3	-	1	2	3	L2, L3
Evaluate energy losses in pipe systems and the impact of fluid jets on different vane geometries.	3	3	3	2	3	-	-	2	3	L3
Illustrate the working principles and performance characteristics of impulse and reaction turbines along with their governing systems.	3	2	3	2	3	1	1	3	3	L3, L4
Compare the construction, operation, and performance of centrifugal and reciprocating pumps in various engineering applications.	3	2	3	2	3	1	1	3	3	L3, L4

SYLLABUS

UNIT I

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure-Manometers Piezometer, U-tube, inverted and differential manometers, Pascal's & hydrostatic laws.

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation, and vorticity.Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences, and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow.

UNIT II

Fluid dynamics: surface and body forces -Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies.Calculation of metacenter height.Stability analysis and applications.Closed conduit flow: Reynold's experiment-Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

Applications: Marine Ship Design, Pressure Measurement In Industrial Design

UNIT III

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, non-depersonalization of equations, Method of repeating variables and Buckingham Pi Theorem.

UNIT IV

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Franci’s turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design-draft tube-theory

UNIT V

Performance of hydraulic turbines: Geometric similarity. Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling.Fluidies amplifiers, sensors and oscillators.Advantages, limitations and applications.

Centrifugal pumps: classification, working, work done manometric head- losses and efficiencies-specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

Reciprocating pumps: Working.Discharge, slip, indicator diagrams.

Applications: municipal water supply and treatment systems Hydropower plant operations

Text Books:

1. Y. A, Cengel, J.M. Cimbala, Fluid Mechanics, Fundamentals Applications, 6/e, McGraw Hill Publications. 2019. and2. Dixon, Fluid Mechanics and Thermodynamics of Turbomachinery, 7/e. Elsevier Publishers, 2014,

Reference Books:1. PN Modi and SM Seth, Hydraulics & Fluid Mechanies including Hydraulics Machines.Standard Book House, 2017.

2. RK Bansal, Fluid Mechanics and Hydraulic Machines, 10/e, Laxmi Publications (P) Ltd, 2019.
3. Rajput, Fluid Mechanics and Hydraulic Machines, S Chand & Company, 2016.
4. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering. SK Kataria& Sons, 2013
5. D. Rama Durgaiah, Fluid Mechanics and Machinery, 1/e, New Age International, 2002.

Online Learning Resources:
https://archive.nptel.ac.in/courses/112/105/112105206/
https://archive.nptel.ac.in/courses/112/104/112104/18/
https://www.edx.org/learn/fluid-mechanics
https://onlinecourses.nptel.ac.in/noc20 ce30/previewnptel.ac.in
www.coursera.org/learn/fluid-powerera

INDUSTRIAL MANAGEMENT

Course Title: INDUSTRIAL MANAGEMENT	**Course Code: R24MEPC10**
Teaching Scheme:(L: T:P) : 3:0:0	**Credits:3**
Type of Course: LECTURE	
Continuous Internal Evaluation: 30 Marks	**Semester End Exam: 70 Marks**
Pre requisites: To succeed in Industrial Management, Students should have a basic knowledge about productivity, work study, quality control, financial management, and project planning. This foundation will support effective learning and application of industrial management techniques**.**	

Course Objectives:

The objectives of the course are to

- Introduce the scope and role of industrial engineering and the techniques for optimal design of layouts
- Illustrate how work study is used to improve productivity
- Explain TQM and quality control techniques
- Introduce financial management aspects and
- Discuss human resource management, value analysis and project management

Course Outcomes	**PO1**	**PO2**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**BT LEVEL**
Explain the role, development of Industrial Engineering, while understanding layout design strategies.	2	2	-	-	-	-	-	-	2	-	L2
Apply work study techniques to improve efficiency and productivity in industrial operations.	3	-	-	3	-	3	-	-	-	3	L3
Utilize statistical quality control tools and implement Total Quality Management practices	4	4	4	-	4	-	-	-	-	4	L3
Analyze financial statements, prepare budgets, and evaluate investment decisions through capital budgeting techniques.	4	-	-	-	-	-	-	-	4	-	L4
Demonstrate knowledge of human resource management functions and apply project management techniques to plan and control projects	-	-	-	3	-	-	3	-	4	3	L3

SYLLABUS

UNIT-I

Introduction: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.

Plant Layout: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and breakdown maintenance.

UNIT-II

Work Study: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

UNIT-III

Statistical Quality Control: Quality control, Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts X and R-charts X and S charts and their applications, numerical examples.

Total Quality Management: zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma-definition, basic concepts

UNIT-IV

Financial Management: Scope and nature of financial management, Sources of finance, Ratio analysis, Management of working capital, estimation of working capital requirements, stock management, Cost accounting and control, budget and budgetary control, Capital budgeting - Nature of Investment Decisions - Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR, numerical problems.

UNIT-V

Human Resource Management: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

Value Analysis: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

Project Management: Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM)

Text Books:

1. O.P Khanna, Industrial Engineering and Management, DhanpatiRai Publications (P) Ltd, 2018.
2. Mart and Telsang. Industrial Engineering and Production Management, S. Chand & Company Ltd. New Delhi, 2006.

Reference Books:

1. Bhattacharya DK, Industrial Management, S. Chand, publishers, 2010.
2. J.G Monks, Operations Management, 3/e, McGraw Hill Publishers 1987.

3. T.R. Banga, S.C Sharma, N. K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers, 2008.
4. Koontz O'Donnell, Principles of Management, 4/e, McGraw Hill Publishers, 1968.
5. R.C. Gupta, Statistical Quality Control, Khanna Publishers, 1998.
6. NVS Raju, Industrial Engineering and Management, l/e, Cengage India Private Limited, 2013.

Online Learning Sources

https://onlinecourses.nptel.ac.in/noc21_me15/preview
https://www.edx.org/learn/industrial-engineering
https://www.youtube.com/playlist?list=PL299B5CC87110A6E7
https://www.youtube.com/playlist?list=PLbjTnj-t5Gkl0z3OHOGK5RB9mvNYvnImW

FLUID AND MECHANICS AND HYDRAULIC MACHINES LAB

COURSE TITLE:FLUID AND MECHANICS AND HYDRAULIC MACHINES LAB	**COURSE CODE:R24MEPC11**
TEACHING SCHEME (L: T:P): 0:0:3	**CREDITS:1.5**
TYPES OF COURSE: PRACTICAL	
CONTINUOUS INTERNAL EVALUATION:30 MARKS	**SEMESTER END MARKS:70**
PRE REQUISITES: Concepts like Newton's laws, heat transfer, and thermodynamics, understanding of force, stress, strain, and energy conservation, Engineering Mechanics (Statics &Dynamics) Prior coursework or understanding of forces in equilibrium, torque, and motion. Mathematics (Calculus and Differential Equations) Ability to handle rate equations, integration, and differential heat/mass transfer problems. Thermodynamics (Intro level) Laws of thermodynamics, heat engines, entropy, etc.	

Course Objectives:

- To give the practical exposure about fundamentals of fluid mechanics and hydraulics.
- To provide practical knowledge about the turbo-machinery
- To provide practical knowledge about the centrifugal pump and reciprocating pump.

Course Outcomes	PO1	PO2	PO3	PO4	PSO1	PSO2
Conduct experiments to evaluate the impact of jets and performance of impulse turbines (e.g., Pelton wheel).	3	2	1	3	1	2
Analyze and interpret the performance characteristics of reaction turbines such as Francis and Kaplan turbines.	3	2	1	3	1	2
Evaluate the efficiency and operational behavior of various pumps and flow meters used in fluid systems.	3	2	1	3	1	2

List of Experiments

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturi meter.

9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipeline.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.

Virtual Lab:

1. To study different patterns of a flow through a pipe and correlate them with the Reynolds number of the flow. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/reynolds/introduction.html)
2. To calculate Total Energy at different points of venture meter. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/bernoulli/introduction.html).
3. To calculate the flow (or point) velocity at center of the given tube using different flow rates. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/pitot/introduction.html)
4. To determine the hydrostatic force on a plane surface under partial submerge and full submerge condition. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/cop/introduction.html).
5. To determine the discharge coefficient of a triangular notch. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/notch/introduction.html)
6. To determine the coefficient of impact of jet on vanes. (https://fm-nitk.vlabs.ac.in/exp/impact-of-jet).
7. To determine friction in pipes. (https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/index.html).

MANUFACTURING PROCESSES LAB

Course Title: MANUFACTURING PROCESSES LAB	**Course Code:R24MEPC12**
Teaching Scheme(L: T:P):0:0:3	**Credits:1.5**
Type of Course: PRACTICAL	
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Understand basic engineering concepts and material properties, including how metals and plastics behave under heat and force. Be trained in workshop safety and proper use of tools and protective equipment for hands-on manufacturing processes.	

Course Overview:
This course introduces students to foundational **knowledge** of manufacturing processes such as pattern making, molding, and welding. Through **application**, learners perform hands-on activities including gas cutting, soldering, and sheet metal operations. Students will also **analyze** (Analyzing) differences between traditional and modern fabrication methods like injection molding, blow molding, and 3D printing. By the end of the course, students will be able to **evaluate** and **create** simple components and assemblies using a variety of manufacturing techniques..

Course Objective:

Acquire practical knowledge on Metal Casting, Welding, Press Working and Processing of Plastics.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PSO1**	**BT LEVEL**
Demonstrate pattern preparation and production of casting with sand casting technique.	3	3	3	3	2	L1, L2, L3
Demonstrate metal forming operations for shaping materials.	3	3	3	2	2	L1, L2, L3
Perform arc welding, gas welding and brazing operations for joining metals.	3	3	3	2	2	L2, L3,L6
Become familiar with processing of plastics.	3	3	3	1	2	L1, L2, L3
Identify suitable manufacturing processes for producing components with different materials.	3	3	3	1	2	L2, L3

List of Experiments

1. Design and making of pattern
   a. Single piece pattern
   b. Split pattern
2. Mould preparation
   a. Straight pipe
   b. Dumble
3. Gas cutting and welding
4. Manual metal arc welding
   a. Lap joint
   b. Butt joint
5. Injection Molding
6. Blow Molding
7. Simple models using sheet metal operations
8. To weld using Spot welding machine
9. To join using Brazing and Soldering
10. Bending and other operations
11. Deep drawing and extrusion operations.
12. To make simple parts on a 3D printing machine

References/Manuals:

1. Manufacturing Technology -Vol I- P.N. Rao- TMH
2. Laboratory Manual

VirtualLab:

1. Tostudyandobservevariousstagesofcastingthroughdemonstrationofcasting process.(https://virtual-labs.github.io/exp-sand-casting-process-dei/theory.html)

2. Toweldandcutmetalsusinganoxyacetyleneweldingsetup.(https://virtual-labs.github.io/exp-gas-cutting-processes-iitkgp/index.html).

3. To simulate Fused deposition modelling process (FDM) (https://3dpdei.vlabs.ac.in/exp/simulation-modelling-process) (https://altair.com/inspire-mold/

PYTHON PROGRAMMING LAB

Course title: PYTHON PROGRAMMING LAB (SKILL ENHANCEMENT COURSE)	**Course Code: R24MESC01**
Teaching Scheme (L: T:P): 0:1:2	**Credits:2**
Type of Course: Tutorial+ Practical	
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: To succeed in the Python Programming course, students should have a basic understanding of computer usage, including file handling and typing. Familiarity with mathematical logic, such as arithmetic operations and logical reasoning, is important. A general awareness of algorithmic thinking (using flowcharts or pseudo code) and a willingness to learn problem-solving techniques will help students grasp programming concepts more easily.	

Course Objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists ,Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these

After completion of the course, students will be able to

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO11	PSO1	BT LEVEL
CO1: Showcase adept command of Python syntax, utilizing variables, data types, control structures, functions, modules, and exception handling to engineer efficient code solutions.	3	3	3	3	3	2	1	L3
CO2: Apply Python programming concepts to solve a variety of computational problems.	3	3	3	2	3	2	2	L3
CO3: Understand the principles of object-oriented programming (OOP) in Python, including classes, objects, inheritance, polymorphism, and encapsulation, and apply them to design and implement Python programs.	3	3	3	3	3	2	1	L6
CO4: Become proficient in using commonly used Python libraries and frameworks such as JSON, XML, NumPy, pandas.	3	3	3	3	3	2	1	L3
CO5: Exhibit competence in implementing and manipulating fundamental data structures such as lists, tuples, sets, dictionaries.	3	3	3	3	3	2	2	L3

SYLLABUS

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupiter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associatively, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers with in an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.

   i)Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bitwise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in given string or not.
5. Write a program to perform the given operations on a list:

   i. Addition ii .Insertion iii.slicing
6. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple () Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between uples and Dictionaries, using zip () Function, Sets, Set Methods, Frozen set.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).

3.Write a program to check if a given key exists in a dictionary or not.

4. Write a program to add a new key-value pair to an existing dictionary.

5. Write a program to sum all the items in a given dictionary.

UNIT-IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Pythons and os. path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes VData Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output files should have only lower-case words, so any upper-case words from source must be lowered.

2. Python program to print each line of a file in reverse order.

3. Python program to compute the number of characters, words, and lines in a file.

4. Write a program to create, display, append, insert and reverse the order of the items in the array.

5. Write a program to add, transpose and multiply two matrices.

6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement sub classes for different shapes like circle, triangle, and square

UNIT-V:

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size,dtype.
4. Python program to demonstrate basic slicing, Integer and Boolean indexing.

5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a panda's data frame and explore the data through the data frame as follows
   a. Apply head () function to the panda's data frame
   b. Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in mat plotlib.

Reference Books:

1. Gowri Shankar S,VeenaA., Introduction to Python Programming,CRC Press.
2. Python Programming, S Sridhar,J Indumathi,VMHariharan,2nd Edition,Pearson, 2024
3. Introduction to Programming Using Python,Y.DanielLiang,Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus
3. Python for Data Science, AI & Development | Coursera

QUANTITATIVE APTITUDE & LOGICAL REASONING

Course Title: QUANTITATIVE APTITUDE & LOGICAL REASONING	**Course Code: R24HS04**
Teaching Scheme (L: T:P): 0:1:2	**Credits:2**
Type of Course :Tutorial+ Practical	
Continuous Internal Evaluation:30 Marks	**Semester End Exam:70Marks**
Pre requisites: To succeed in the Quantitative Aptitude & Logical reasoning course, students should have a basic understanding arithmetic, algebra, and geometry from school level mathematics. Analytical thinking and English comprehension skills for interpreting logical patterns and problems.	

Course outcome:

Cos	PO1	PO2	PO3	PO4	PO5	PO11	PSO1	BT LEVEIL
CO1: Mastery of Key Concepts– Understand number systems, percentages, time/work, profit/loss, and series completion.	3	2	1	2	1	-	1	L2
CO2: Improved Problem-Solving Skills – Solve mathematical and logical problems with speed and accuracy.	3	3	2	3	1	-	1	L3
CO3: Enhanced Analytical Thinking – Develop critical thinking for reasoning puzzles and real-life challenges.	2	3	2	3	2	-	1	L4
CO4: Competitive Exam Preparedness–Bewell-prepared for exams requiring aptitude and reasoning.	3	2	1	2	2	1	2	L3

Course objective:

1. Build a strong foundation in quantitative aptitude and logical reasoning.
2. Enhance problem-solving skills for topics like percentages, profit and loss, time and work, and logical reasoning puzzles.
3. Improve speed, accuracy, and critical thinking for efficient problem-solving.
4. Prepare students for competitive exams and real-world applications of math and logic.

Course outcome:

1. **Mastery of Key Concepts:** Students will gain a solid understanding of essential topics in aptitude and logical reasoning, including number systems, percentages, time and work, profit and loss, and series completion.
2. **Improved Problem-Solving Skills:** Students will be able to solve complex mathematical and logical problems with increased speed and accuracy.
3. **Enhanced Analytical Thinking:** Students will develop critical thinking abilities, enabling them to approach reasoning puzzles and real-life challenges effectively.
4. **Competitive Exam Preparedness:** Students will be well-prepared to tackle competitive exams that require strong aptitude and reasoning skills.

Aptitude:

Unit 1: Number System: Speed Math's, Numbers, Factors, Prime & Co-Primes, LCM, HCF, Divisibility rules, finding unit place digit and last two digits of an expression.

Averages and Ages: Average of different groups, change in averages by adding, deleting and replacement of objects, problems on ages.

Ratio, Proportion and Variations: Definition of Ratio, Definition of Proportion, Types of ratios, Types of proportions, mixture model, age model, salary model questions, Direct and indirect proportion. **Allegation and mixtures**: Allegation rule.

Unit 2: Percentages: Converting fractions and decimal into percentages, successive percentage, populations, expenditure and savings.

Profit and loss: Relation between Cost price and Selling price, Discount and Marked price, Gain or Loss percentages on selling price

Simple and Compound Interest: Problems on Interest (I), Amount (A), Principal (P)and Rate of Interest(R), Difference between the simple interest and compound interest for 2 and 3years.

Unit 3: Time and Work: Men and Days, Work and Wages, Hours and Work, Alternate days concept, Chain rule.

Time and Distance: Difference between the average and relative speeds, reaching the destination late and early, Stopp age time per hour, time and distance between two moving bodies.

Trains, Boats and Streams: Train crossing man, same and opposite directions, Speed ofboat and stream.

Logical Reasoning

Unit 4: Series completion: Number series, Alphabet series and letter series.

Blood Relations: Defining the various relations among the members of a family, Solving Blood Relation Puzzles by using symbols and notations. Problems on Coded relations.

Coding and Decoding: Letter coding, Number coding, Number to letter coding, Matrix coding, Substitution, Mixed letter coding, Mixed number coding, deciphering individual letter codes by analysis.

Direction sense test: Sort of directions in puzzles distance between two points, problems on shadows, Application of triangular triplets.

Unit 5: Clocks: Relation between minute-hour hands, anglevs. time, exceptional cases in clocks

Calendars: Definition of a Leap Year, Finding the odd days, finding the day of any random calendar date, repetition of calendar years.
S

Order and Ranking: Find the ranking From Top/Bottom/Left/Right, Find the total number of persons/Objects.

Text Books:

1. R.S.Aggarwal“QuantitativeAptitude”,Reviseded.,SChandpublication,2017 ISBN:8121924987
2. R.S.Aggarwal“Verbal-Nonverbal Reasoning”,Reviseded.,SChandpublication,2017 ISBN:

E- resources:

- https://www.indiabix.com/aptitude/questions-and-answers/
- https://www.tutorialspoint.com/quantitative_aptitude/
- https://www.careerbless.com/aptitude/qa/home.php

ENVIRONMENTAL SCIENCE

Course Title: ENVIRONMENTAL SCIENCE	CourseCode:R24MC03
Teaching Scheme (L: T:P): 2:0:0	Credits: -
Type of Course: LECTURE	
Continuous Internal Evaluation: 30Marks	Semester End Exam: 70Marks
Pre requisites: To succeed in the Environmental Science course, students should have a basic knowledge of high school-level biology, physics, and chemistry. Awareness of environmental issues like pollution, climate change, and conservation is helpful. Interest in sustainability and nature will enhance understanding and engagement.	

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers

Course Outcomes:

After completion of the course, students will be able to

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO11	PSO1	BT LEVEL
CO1: Understand the scope, importance, and multidisciplinary nature of environmental studies, and analyze the exploitation of natural resources.	2	3	1	2	2	1	2	2	L2,L4
CO2: Describe the structure, function, and energy flow in ecosystems, and understand the importance of biodiversity and its conservation.	3	2	2	3	2	1	3	1	L2,L3
CO3: Evaluate the causes, effects, and control measures of different types of environmental pollution, and understand the strategies for solid waste management.	3	3	2	3	3	2	2	1	L4,L5
CO4: Examine the concept of sustainable development, urban environmental issues, and the role of environmental ethics and legislation in protecting the environment.	3	2	3	3	3	2	3	2	L4,L5
CO5: Analyze the relationship between human population growth and environmental degradation, and evaluate the role of population management and health programs in sustainable development.	3	2	2	2	3	2	3	1	L4,L5

SYLLABUS

UNIT-I

Multi-disciplinary Nature of Environmental Studies: –Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies– Timberextraction–Mining,damsandothereffectsonforestandtribalpeople–Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmentaleffectsofextractingandusingmineralresources,casestudies–Foodresources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources.

UNIT-II

Ecosystems: Concept of an ecosystem. –Structure and function of an ecosystem–Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grass land eco system
c. Desert eco system.
d. Aquatic eco systems(ponds, streams ,lakes ,rivers, oceans, estuaries)

BiodiversityanditsConservation:Introduction0Definition:genetic,speciesandecosystem diversity – Bio-geographical classification of India –Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-III

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects, and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone, and landslides.

UNIT-IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns.

Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products.

Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT-V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Textbooks:

1. Text book of Environmental Studies for Undergraduate Courses ErachBharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies",Pearsoneducation
3. S. AzeemUnnisa, "Environmental Studies" Academic Publishing Company
4. RaghavanNambiar,"Textbookof Environmental StudiesforUndergraduateCourses as per UGC model syllabus", SciTech Publications (India), Pvt. Ltd.

References:

1. DeekshaDaveandE.SaiBabaReddy,"TextbookofEnvironmentalScience",CengagePu blications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology's Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmipublications.
4. J.GlynnHenryandGaryW.Heinke,"EnvironmentalSciencesandEngineering", Prentice Hall of India Private limited
5. G.R.Chatwal,"A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

Guidelines for B. Tech Honors in Engineering Regulations-R24

(Effective for the students admitted into I year from the Academic Year 2024-2025 onwards)

1) Introduction

The goal of introducing B.Tech (Honors) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

All the students pursuing regular B.Tech with prerequisite CGPA are eligible to the register Honors degree course. **A student has to acquire 18 more credits, in addition to 160 credits (without back log history and meeting other guidelines) required, for the award of the B.Tech Honors degree. Out of the 18 extra credits required to obtain the Honors degree, at least SIX Credits (i.e., two courses of 3 credits each) must be earned from NPTEL / SWAYAM MOOC Courses.** The additional courses shall be advanced subjects in the concerned department / discipline. The department concerned will determine required courses for award of Honors degree. The subjects in the Honors degree would be a combination of core (Theory and Lab) and some electives.

2) Objectives

The objectives of initiating the B.Tech (Honors) degree certification are:

a) To encourage the undergraduates towards higher studies and research
b) To prepare the students to specialize in core Engineering streams
c) To attain the high-level competence in the specialized area of UG programme
d) To learn the best educational and professional skills in the specialized area after the completion of his undergraduate courses.
e) To provide the opportunity to learn the advanced courses m the specified undergraduate programme

3) Applicability and Enrolment

a) To all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology with CGPA of 7.0 up to II Year I Semester (III Semester), without any backlogs and backlog history.

b) It may be noted that both regular degree and Honors degree are to be completed in 4 Years for Regular students and 3 Years for lateral entry admitted students, without any backlog history.

c) For applicability of Honors degree, both regular B.Tech and Honors degree courses shall be successfully completed.

d) Transfer of credits from a particular minor to regular B.Tech or another major degree and vice-versa shall not be permitted

4) Entry level

a) The B.Tech students (both Regular and Lateral Entry) pursing a major degree programme can register for Honors degree at their choice in the same department / allied (as mentioned in AICTE Handbook) offering major degree from IV semester onwards.

b) Students registering for Honors degree shall select the subjects from same branches / department based on the recommendations of BoS committee. For example, if a student pursuing major degree in Electrical & Electronics Engineering, select subjects in Electrical & Electronics Engineering only and he / she will get major and Honors degree in Electrical & Electronics Engineering

c) Students shall be permitted to select a maximum of two subjects per semester from the list of subjects specified for Honors degree other than Lab courses.

d) The students shall complete Honors degree without supplementary appearance within stipulated period as notified by college / JNTU-GV for the completion of regular major B.Tech programme.

e) Honors degree shall not be awarded at any circumstances without completing the regular major B.Tech programme in which a student got admitted

f) If a student is detained due to lack of attendance, he/ she shall not be permitted to register the courses for Honors degree

g) The subjects completed under Honors degree programme shall not be considered as equivalent subjects in case the student fails to complete the major degree programme

h) Students completed their degree shall not be permitted to register for Honors degree

5) Structure of Honors in B.Tech

a) The student shall earn additional 18 credits for award of Honors degree from same branch / department / allied (as mentioned in AICTE Handbook) registered for major degree
b) Students can complete Honors degree courses either in the college or online from platforms like NPTEL/SWAYAM etc…
c) The overall attendance in each semester of regular B.Tech courses and Honors degree courses shall be computed separately
d) Student having less than 65% attendance in Honors courses shall not be permitted for "Honors Course (s) semester end examinations".
e) A student detained due to lack of attendance in regular B.Tech programme shall not be permitted to continue Honors programme
f) The teaching, examinations (internal and external) and evaluation procedure of Honors degree courses offered in offline is similar to regular B.Tech courses
g) Students may choose theory or practical courses to fulfill the minimum credit requirement.
h) Students shall be allowed to take maximum two subjects per semester pertaining to their Honors degree other than lab courses
i) The students registered for minor shall not be permitted to register for B.Tech (Honors)

6) Credits requirement

a) A Student will be eligible to get B.Tech (Honors), if he / she complete an additional 18 credits. These may be acquired either in offline or online like NPTEL / SWAYAM etc by doing 8 / 12 / 16 week courses covering 2 / 3 / 4 credits.
b) The colleges offering Honors degree courses shall be ready to teach the courses in offline at their college in the concerned departments. Curriculum and the syllabus of the courses shall be approved by the Board of Studies.
c) Students shall produce a certificate issued by the NPTEL / SWAYAM etc., conducting agency as a proof of credit attainment.
d) The teaching and evaluation procedure of Honors courses offering in offline mode shall be similar to that of regular B.Tech courses
e) After successful completion of all major and Honors degree courses with specified CGPA the College / University will award B.Tech (Honors)

7) Procedure to Apply for Honors degree

a) The department offering the Honors will announce courses required before the start of the session.

b) The interested students shall apply for the Honors course to the HOD of the concerned department.

c) The whole process should be completed within one week before the start of every session.

d) Selected students shall be permitted to register the courses for Honors degree.

8) To Join in Honors Program

a) Each department offering the Honors degree shall submit the final list of selected students to the principal.

b) The selected students shall submit a joining letter to the Principal through the concerned HoD.

c) The department offering Honors shall maintain the record of student pursing the Honors degree.

d) With the approval of Principal and suggestion of advisor /mentor, students can choose courses from the approved list and shall register the courses within a week as per the conditions laid down in the structure for the Honor degree.

e) Each department shall communicate the Honors courses registered by the students to the time table drafting committee and accordingly time table will be drafting. Time table drafting committee shall see that no clash in time tables.

f) If the student wishes to withdraw / change the registration of subject / course, he/she shall inform the same to advisor/mentor, subject teacher, HoDs of minor department and parent department and Principal within two weeks after registration of the course.

9) Procedure for Monitoring the Progress of the Scheme

The students enrolled in the Honor courses will be monitored continuously at par with the prevailing practices and examination standards. An advisor / mentor from parent department shall be assigned to a group of students to monitor the progress.

10) Allocation of seats for Honors degree

Total number of seats offered for Honors degree shall be a maximum of 60 (based on merit).

11) Examinations

a) The examination for the Honors degree courses offered in offline shall be conducted along with regular B.Tech programme.

b) The examinations (internal and external) and evaluation procedure of Honors degree courses offered in offline is similar to regular B.Tech courses.

c) It may be noted that both major and Honors courses (from IV Semester to VII Semester) are to be completed in 4 Years for Regular students and 3 Years for lateral entry admitted students.

d) There is no supplementary examination for the failed subjects in an Honors degree programmeS.

e) Examination Fees: Examination Fees will be as per the College norms

f) For awarding the class, CGPA obtained in Major Degree only will be considered.

g) For awarding the Honor's, obtained credits only will be considered.

h) The student can complete these MOOCs NPTEL courses during III year I semester to IV year II semester course completion and these courses will be included in the IV year II Semester grade memo.

College offering B.Tech Honors Degree in the following domains, and the student can take any one of domain to get B.Tech Honors by satisfying eligibility criteria.

S.No	Specialization	Offered By	Honors (For Students)
1	**Additive Manufacturing**	MECH	MECH

1. Additive Manufacturing

S.No	Subject Code	Year of Study	Subject	L	T	P	C
1	R24 MEAM 201	II-II	Additive Manufacturing Technologies	3	0	0	3
2	R24 MEAM 302	III-I	Rapid Manufacturing	3	0	0	3

3	R24 MEAM 303	III-II	Automation in Manufacturing	3	0	0	3
4	R24 MEAM 404	IV-I	Manufacturing Systems Technology	3	0	0	3
5	R24 MEAM 405	---	NPTEL/MOOC Course-I(12 Weeks course/excluding the above subjects)	0	0	0	3
6	R24MEAM 406	---	NPTEL/MOOC Course-II(12 Weeks course/excluding the above subjects)	0	0	0	3
			Total	**12**	**0**	**0**	**18**

Additive Manufacturing Technologies

Course Title: **Additive Manufacturing Technologies**	**Course Code**: **R24ADT201**
Teaching Scheme(L:T:P): 3 0 0	**Credits**: 3
Type of Course: Lecture	
Continuous Internal Evaluation:30Marks	**Semester End Exam**:70 Marks
Pre requisites: Basic understanding of engineering materials and mechanical properties. Familiarity with fundamental computer programming and engineering drawing concepts. Introductory knowledge of manufacturing processes and industrial systems.	

Course Overview:

This course enables students to remember and understand fundamental concepts of material properties and their relevance in integrated product design and manufacturing. Students will apply principles of computer-aided design (CAD), including 3D transformations and curve fitting, to develop effective product models. They will analyze machining processes and implement computer-aided process planning (CAPP) for efficient manufacturing workflows. Through evaluation of CNC part programming techniques, including G & M codes and canned cycles, students will enhance automation capabilities. Finally, learners will create strategies for quality improvement by integrating lean manufacturing, Just-in-Time (JIT), and cost-effective quality management practices.

Course Objectives:

1. To introduce the foundational concepts of material properties and their significance in integrated product design and manufacturing systems.
2. To develop understanding of computer-aided design (CAD) principles, including 3D transformations and curve fitting techniques for effective product modeling.
3. To familiarize students with process planning techniques for basic machining operations and the implementation of computer-aided process planning (CAPP).
4. To provide knowledge on CNC part programming, including motion control, G & M codes, and the application of canned cycles in modern manufacturing.
5. To impart knowledge on quality systems engineering, including Just-in-Time (JIT), lean manufacturing concepts, and quality cost management.

Course Outcomes:

Course Code	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	BT
R24ADT201.1	Explain various manufacturing paradigms and critically analyze their evolution and relevance	3	3	2	1	2	2	2	L1, L2
R24ADT201.2	Apply economic principles like economies of scale and complementarities to manufacturing systems and assess the impact of additive manufacturing technologies on supply chains.	3	3	2	2	3	3	2	L2, L3
R24ADT201.3	Select appropriate materials for additive manufacturing, evaluate their functional characteristics, and identify post-processing techniques for enhanced part performance and accuracy.	3	3	3	3	3	2	3	L2, L4
R24ADT201.4	Interpret quality assurance standards and certification protocols for additive manufacturing, and develop strategies to ensure repeatability and reliability in production.	3	3	3	3	3	3	2	L3
R24ADT201.5	Design strategic roadmaps for additive manufacturing adoption by integrating modern business models	3	3	3	3	3	3	3	L4

SYLLABUS

UNIT- I

Manufacturing Paradigms: Significance of manufacturing, Different manufacturing paradigms, craft production, mass production, mass customization, distributed manufacturing, servitisation, Technology and manufacturing, Laws of manufacturing.

Advances in Manufacturing and SCM: Additive manufacturing, and its impact over the product development cycles. Reconfiguring of supply chain models. Contemporary initiatives in manufacturing: Advanced Manufacturing (US), e-factory (Japan), Industries 4.0 (Germany), Intelligent Manufacturing (China) and Make in India (India). **CO's: CO1**

UNIT- II

Economics of Manufacturing: Firms' market microstructure for manufacturing. Economies of scale, un scale, and scope. Manufacturing production functions. Mathematics of complementarities. Complementarities in production.

Additive Manufacturing Technologies: Technology basics and classification. Metal additive manufacturing and significance of laser powder bed fusion. Challenges in realization of metal additive manufactured parts with adequate strength and integrity. Input data formats and data generation from physical artefacts. Build environment and concept of process window. Typical pitfalls and corrective measures.

Industrial Applications: Part Substitution, Prototyping, Tooling and Reengineering. Product Design and Development Models based on Metal Additive Manufacturing. Spare part management for engineering conglomerates and users of legacy systems. MRO and refurbishment models based on metal additive manufacturing. **CO's: CO2**

UNIT- III

AM Materials: Functionalities of AM materials – metals, plastics, ceramics and composites. Use of certified Materials and challenges in adapting new materials. Comparisons of AM materials with cast or forged structural alloys. Common Defects in AM Parts and their implications

AM Business Functionalities: Essentials of AM plant infrastructure, Importance of post processing, Dimensional accuracy, Surface finish and strength aspects. Powder handling and recycling.

Opportunities for Value Addition: Light Weighting, Part Consolidation and Topology Optimization. Functional integration. **CO's: CO3**

UNIT- IV

Quality: Process Certification, General Approach to Part Certification, Process Monitoring| Industry Certifications: AS, LR. Challenges in Certification and Prove Out Repeatability, Reliability and Predictability, Control Measures.

Opportunity Identification: Selection of Right Parts, Assessment of Shortlisted Components, Use Cases and Business Cases based on Techno-Commercials, Impact on Sub-systems and Systems

CO's: CO4

UNIT- V

Road Mapping: Challenges in AM Adoption and Change Management Approach, Wipro3D Adoption Approach, Benchmarking organizational Goals with reference to AM, Value Estimation, Economic characteristics of additive manufacturing, Impact of additive manufacturing on firms' payoff functions and market microstructure.

Manufacturing Architecture and Business Models for Manufacturing: Cloud manufacturing. Cooperative and responsive manufacturing. Data-driven manufacturing and digital factory, Human-centered manufacturing. Introduction to business models. Manufacturing- as-a-Service (MaaS). Anything-as-a-Service (XaaS).

CO's: CO5

Text Books:

1. Y. Koren, "The Global Manufacturing Revolution", John Wiley & Sons, 2010.
2. Richard D'Aveni, "The 3-D Printing Revolution", Harvard Business Review, May 2015.
3. John O. Milewski, "Additive Manufacturing Technologies", Springer, 2017

References:

1. Regtien, P. P. L., Sensors for mechatronics, Elesevier, USA, 2012.
2. Parr, A. A., Hydraulics and pneumatics, Elsevier, 1999.

Rapid Manufacturing

Course Title: Rapid Manufacturing	**Course Code**: **R24ADT202**
Teaching Scheme(L:T:P):3 0 0	**Credits**:3
Type of Course: Lecture	
Continuous Internal Evaluation:30Marks	**Semester End Exam**:70 Marks
Pre requisites: Basic knowledge of manufacturing processes and product design principles. Familiarity with CAD software and 3D modeling techniques. Introductory understanding of materials science and engineering.	

Course Overview:

This course introduces the fundamentals of Rapid Manufacturing (RM), Modular Design, and Reverse Engineering to support efficient and agile product development. It explores RM processes, materials, post-processing, and cost analysis, supported by practical demonstrations and case studies. Digital tools are integrated to illustrate their impact on accelerating Rapid Product Development.

Course Objectives:

1. To understand the principles of Rapid Manufacturing and Modular design and reverse engineering for efficient product development.
2. To explore various Rapid Manufacturing processes and their applications through theory and demonstrations.
3. To analyze RM materials, post-processing techniques, and cost factors in manufacturing applications.
4. Illustrate the role of digital tools and case studies in accelerating Rapid Product Development.

Course Outcomes:

Course Code	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO8	PO9	PO10	PO11	PSO1	BT
R24ADT202.1	To understand the fundamental concepts of Rapid Manufacturing and its role in modern product design.	3	-	-	-	-	-	-	-	-	2	2	L1
R24ADT202.2	Understand Design for Modularity and the Reverse Engineering	3	2	2	-	2	-	-	-	-	2	2	L2
R24ADT202.3	Analyze and select a Rapid manufacturing technology for a given component.	3	3	3	3	3	-	-	-	-	3	2	L2, L4

R24ADT202.4	Describe the materials used and Post-processing techniques in Rapid Manufacturing	3	-	2	-	3	-	-	-	-	2	3	L2, L4
R24ADT202.5	Illustrate the significance of Rapid Product development.	3	2	3	-	3	2	2	2	2	2	3	L3

SYLLABUS

UNIT- I Introduction

Introduction to Rapid Manufacturing (RM), Product Design Process, Different manufacturing systems, Introduction to Rapid Prototyping (RP), Need of RP in context to batch production

CO's: CO1

Self Learning Topics-Industry 4.0 and its Impact on Rapid Manufacturing, AI-Driven Generative Design in Product Development

UNIT- II Modularity

Design for Modularity, Reverse Engineering, 3D measurement: laboratory demonstration, 3D Scanning with Structured Light and Laser Technology. **CO's: CO2**

Self Learning Topics- Topology Optimization for Modular Product Design, Artificial Intelligence in Reverse Engineering

UNIT- III Powder based RM processes

Polymerization and Powder based RM processes, Liquid based, and Sheet stacking RM processes, 3D printing RM processes and laboratory demonstration, -Material and Multi-Color 3D Printing Techniques **CO's: CO3**

Self Learning Topics- Multi Printing with Smart Materials (Shape Memory Alloys, Conductive Polymers)

UNIT - IV Beam Deposition RM processes

Beam Deposition RM processes, and materials in RM, Post-processing and costing in RM, Metal Additive Manufacturing: SLM, DED, and EBAM **CO's: CO4**

Self Learning Topics- Mechanical Properties and Testing of RM Components

UNIT- V Rapid Product Development

Rapid Product Development (CAD/CAE/CIM), Rapid Product Development (Software demonstration), and case studies on RM **CO's: CO5**

Self Learning Topics- Cyber security Challenges in Digital Manufacturing Environments, Use of Artificial Intelligence in Product Simulation, CAD-CAE Integration for Functional Rapid Prototyping

Text Books:

1. Kamrani, A.K. and Nasr, E.A., 2010. Engineering design and rapid prototyping. Springer Science & Business Media.Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2001.
2. Gebhardt, A., 2011. Understanding additive manufacturing.

3. Gibson, I., Rosen, D.W. and Stucker, B., 2014. Additive manufacturing technologies (Vol. 17). New York: Springer.

References:

1. Hopkinson, N., Hague, R. and Dickens, P. eds., 2006. Rapid manufacturing: an industrial revolution for the digital age. John Wiley & Sons.
2. Pham, D. and Dimov, S.S., 2012. Rapid manufacturing: the technologies and applications of rapid prototyping and rapid tooling. Springer Science & Business Media.

Automation in Manufacturing

Course Title: Automation in Manufacturing	**Course Code: R24ADT303**
Teaching Scheme(L:T:P): 3 0 0	**Credits:**3
Type of Course: Lecture	
Continuous Internal Evaluation:30Marks	**Semester End Exam:**70 Marks
Pre requisites: Fundamental knowledge of mechanical and electrical engineering concepts. Basic understanding of electronics, including sensors and actuators. Familiarity with programming logic and microprocessor basics. Introductory exposure to manufacturing processes and control systems.	

Course Overview:

This course provides a comprehensive introduction to automation and mechatronics in manufacturing, covering key components such as sensors, microprocessors, electrical drives, and mechanical systems. It emphasizes the integration of hydraulic and pneumatic systems, CNC technology, and programming for modern automated systems. Practical knowledge is reinforced through component selection, fabrication, and system analysis

Course Objectives:

1. Understand the importance of automation and mechatronics in manufacturing and the basic components of an automated system.
2. Learn how to select and fabricate components for automation and understand the function of sensors in automation systems.
3. Study the use of microprocessors for data acquisition and signal conditioning, and understand electrical drives in automation.
4. Learn about mechanisms like ball screws and cams, and understand how hydraulic systems work in automation.
5. Study pneumatic systems and understand the basics of CNC technology and its programming in automation.

Course Outcomes :

Course Code	Course Outcomes	PO1	PO2	PO3	PO5	PO6	PO11	PSO1	BT
R24ADT203.1	Explain the design and development of automated systems in the manufacturing.	3	2	2	-	-	-	3	**L1, L2**
R24ADT203.2	Describe working of various blocks of automated system.	3	2	-	2	-	-	3	**L2**
R24ADT203.3	Illustrate the principle of operation and construction details of sensors/transducers, actuators, drives and mechanisms, hydraulic and pneumatic systems for automation.	3	-	2	3	1	-	2	**L3**
R24ADT203.4	Summarize the microprocessor technology, programming and CNC technology	2	-	2	2	-	1	-	**L3, L4**
R24ADT203.5	Use automation principles for manufacturing industrial applications.	-	-	3	3	2	-	2	**L3, L5**

SYLLABUS

UNIT- I

Introduction: Importance of automation in the manufacturing industry. Use of mechatronics, systems required.

Design of an automated system: Building blocks of an automated system, working principle and examples. **CO's: CO1**

Self Learning Topics- Industry 4.0, Smart Manufacturing, Robotics in Automation

UNIT- II

Fabrication: Fabrication or selection of various components of an automated system, specifications of various elements, use of design data books and catalogues.

Sensors: Study of various sensors required in a typical automated system for manufacturing, construction and principle of operation of sensors. **CO's: CO2**

Self Learning Topics- Advanced Sensor Technologies, Sensor Fusion, Sensor Networks

UNIT- III

Microprocessor technology: Signal conditioning and data acquisition, use of microprocessor or micro controllers, configurations, working.

Drives: Electrical drives, types, selection criteria, construction and operating principle.

CO's: CO3

Self Learning Topics- Embedded Systems, Power Electronics, Servo and Stepper Motors

UNIT - IV

Mechanisms: Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Hydraulic systems: Hydraulic power pack, pumps, valves, designing of hydraulic circuits.

CO's: CO4

Self Learning Topics- Advanced Actuation Systems, Hydraulic and Pneumatic Systems, FEA and MBD

UNIT V

Pneumatic systems: Configurations, compressors, valves, distribution and conditioning.

CNC technology: Basic elements, interpolators and programming. **CO's: CO5**

Self Learning Topics- Smart Pneumatic Systems, CNC Programming, Hybrid Manufacturing

Text Books:

1. Boltan, W., "Mechatronics: electronic control systems in mechanical and electrical engineering", Longman, Singapore, 1999.
2. Groover, M.P., "Automation, Production Systems, and Computer-Integrated Manufacturing", Prentice Hall, 2001.
3. Gaonkar, R.S., "Microprocessor architecture, programming, and applications with the 8085", Penram International Publishing (India), Delhi, 2000.

References:

1. Regtien, P. P. L., "Sensors for mechatronics", Elsevier, USA, 2012.
2. Parr, A. A., "Hydraulics and pneumatics", Elsevier, 1999.

Handbooks:

1. Smid, P., "CNC Programming Handbook", Industrial Press, New York, USA, 2008.
2. Rothbart, H. A., "CAM Design Handbook", McGraw-Hill, 2004.
3. Norton, R. L., "Cam Design and Manufacturing Handbook", Industrial press Inc, 2002.

Manufacturing Systems Technology

Course Title: Manufacturing Systems Technology	**Course Code: R24ADT404**
Teaching Scheme(L:T:P): 3 0 0	**Credits:**3
Type of Course: Lecture	
Continuous Internal Evaluation:30Marks	**Semester End Exam:**70 Marks
Pre requisites: Basic understanding of materials science and mechanical design principles. Familiarity with CAD tools and 3D modeling techniques. Introductory knowledge of manufacturing processes and CNC operations. Basic concepts in statistics and quality control methods	

Course Overview:

This course integrates material science, CAD-based product design, and manufacturing systems with a focus on machining, CNC programming, and quality engineering. It covers computer-aided process planning (CAPP), motion control, and G/M codes for CNC operations. The curriculum also emphasizes statistical quality control, Six Sigma, and robotics in modern manufacturing environments.

Course Objectives:

1. To understand material properties and integrated product design using CAD, transformations, and curve modeling
2. To learn machining principles, machine tool design, and computer-aided process planning (CAPP) techniques
3. To gain knowledge of CNC programming, motion control, G/M codes, and CNC coordinate systems.
4. To understand quality engineering principles, TPS, quality cost analysis, and experimental design for product improvement.
5. To explore statistical quality control, robust design, Six Sigma, and the role of robotics in automated manufacturing

Course Outcomes :

Course Code	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO9	PO10	PO11	BT
R24ADT404.1	Understand the concepts of computer aided designing	3	2	2	1	3	1	–	–	2	L2
R24ADT404.2	Apply the principles in process planning.	3	3	3	2	2	1	–	2	2	L2
R24ADT404.3	Gain knowledge on computer numerical control systems	3	2	3	2	3	-	–	2	2	L1
R24ADT404.4	Distinguish between quality improvement methods.	2	3	3	2	2	1	1	2	3	L4

R24ADT404.5	Understand the dynamic changes that are taking place in business environment		2	2	1	–	3	2	3	3	L2

SYLLABUS

UNIT- I

Introduction: Manufacturing properties of materials

Integrated product designing: Manufacturing systems approach, historical perspective of design, material handling systems.

Computer aided designing: Introduction, homogeneous transformation, 3-D transformations, parametric and nonparametric equations, hermite cubic spline fit, Bezier curves, introduction to manufacturing processes **CO's: CO1**

Self Learning Topic: Comparative study of material properties for manufacturing, Evolution of product design from manual to digital approaches

UNIT- II Machining Processes

Principles and Process Planning of Basic Machining Processes, Machine Tools Design.

Computer Aided Process Planning: Developing a process plan, determining machining conditions and machining time, machining cost evaluation, estimation of tool life, generative CAPP method and knowledge based process planning. **CO's: CO2**

Self Learning Topic: Steps in process planning for machining operations, Machining time estimation techniques

UNIT- III CNC part programming

Introduction to CNC part programming, motion control of NC machines, preparatory functions used in NC programming, G codes, M codes and canned cycles. **CO's: CO3**

Self Learning Topic: Coordinate systems used in NC/CNC machines (absolute vs. incremental), Basics of CNC controllers and drive systems

UNIT - IV

Quality systems engineering: Introduction to quality engineering, Just-in-time manufacturing, toyta production system, pull systems, kanban systems. quality costs, product design, design of experiments, applications of quality loss function, product selection strategies. **CO's: CO4**

Self Learning Topic: Principles of quality engineering and quality assurance, Toyota Production System (TPS) overview

UNIT –V

Cost of quality and statistical quality control: Robust design approaches, taguchi's method, failure mode and effects analysis, product quality improvement methods, quality tools, quality charts, X-bar chart, R-chart.

Robotic Systems Planning and Designing: Six sigma, theory of probability, determining the defective products using probability, sampling based on permutations and combinations, binomial distributions, poisson distribution, normal distribution, fundamental of robotics and its application in automated systems, joint configuration systems of robot. **CO's: CO5**

Self Learning Topic: FMEA (Failure Mode and Effects Analysis) – steps and case studies, Six Sigma methodology (DMAIC framework)

Text Books:

1. R. Thomas Wright, "Manufacturing systems", Goodheart-Willcox Company, 1990.
2. Katsundo Mitomi , "Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics", second edition, CRC press, 1996.
3. Yoram Koren , "Computer control of manufacturing systems", McGraw Hill, 2017

References:

1. Rao, Kundra, and Tewari, "Numerical Control and computer aided manufacturing", Mc Graw Hill ,2017.

Guidelines for B.Tech Minors in Engineering Regulations-R24

(Effective for the students admitted into I year from the Academic Year 2024-2025 onwards)

1) Introduction

Looking to global scenario and as per NEP-2020, Engineering students should have knowledge of subjects from other branches and some advanced subjects of their respective branch in which they are perusing the degree. To complement the same, Institute has decided to take an initiative from Academic Year 2024-2025 (R24 Regulations) by introducing Minors to the students enrolled in B.Tech Program. This gives a provision to the students to pursue Minors other than the discipline in which student got admitted. An aspiring student can choose the courses and laboratories in any other discipline and can get a Minor Degree in the chosen specialization in addition to regular B.Tech Degree. This way undergraduate are not restricted to learn about courses only in the discipline they get admitted to, but can choose courses of their interest to later on take up a career path of their liking.

The students taking up a minor course will get additional credits. A student has to acquire **18 more credits**, **in addition to 160 credits** required, for the award of the minor by fulfilling at least three credits must be earned from NPTEL / SWAYAM MOOC Course and the remaining 12 **credits by doing FOUR Theory** / Integrated courses of 03 credits each (or) **Four Theory courses of 06 credits** either through MOOCS / Regular. The department concerned will determine the required courses for award of minor. The subjects in minor programme would be a combination of mostly core and some electives.

2) Objectives

The objectives of initiating the B.Tech (Minors) degree certification are:

a) To diversify the knowledge of the undergraduates.
b) To make the undergraduates more employable.
c) To have more educational and professional skills after the completion of his UG courses.
d) To give a scope to specialize students in other streams of engineering in addition to the ones they are currently pursuing.

3) Applicability and Enrolment

a) To all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology

b) There shall be no limit on the number of programs offered under Minor. The minor programs in emerging technologies are based on expertise in the respective departments and may also be offered in collaboration with the relevant industries/ agencies.

c) If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned HoD in consultation with BoS.

d) For applicability of minor, both regular B.Tech and minor courses shall be successfully completed.

e) Transfer of credits from a particular minor to regular B.Tech or another major degree and vice-versa shall not be permitted

4) Entry level

a) The B.Tech students (both Regular and Lateral Entry) pursuing a major degree programme can register for minor at their choice in any other department offering minor from IV semester onwards.

b) Students registering for minor shall select the subjects from other branches. For example, if a student pursuing major degree in Electrical & Electronics Engineering shall select the subjects specified for minor in Computer Science and Engineering and he/she will get major degree of Electrical & Electronics Engineering with minor of Computer Science and Engineering.

c) Student pursuing major degree in any engineering branch is eligible to register for minor in any other engineering branch. However, students pursuing major degree in a particular Engineering are not allowed to register for minor in the same engineering branch.

d) Separate CGPA shall be shown on semester and final transcripts of regular B.Tech and minor.

e) Students shall be permitted to select a maximum of two subjects per semester from the list of subjects specified for minor.

f) Minor shall not be awarded at any circumstances without completing the regular major

g) B.Tech programme in which a student got admitted

h) If a student is detained due to lack of attendance, he/ she shall not be permitted to register the courses of minor

i) Students completed their degree shall not be permitted to register for minor

5) Structure of Minor in B.Tech

a) The student shall earn additional 18 Credits for award of minor from other branch/department / discipline registered for major degree.
b) Students can complete minor courses either in the college or in online from platforms like NPTEL/SWAYAM etc.
c) The overall attendance in each semester of regular B.Tech courses and minor courses shall be computed separately
d) Student having less than 65% attendance in minor courses shall not be permitted for appearing "Minor course(s) end semester examinations".
e) A student detained due to lack of attendance in a regular B.Tech programme shall not be permitted to continue minor programme.
f) The teaching, examinations (internal and external) and evaluation procedure of minor courses offered in offline is similar to regular B.Tech courses
g) The students may choose theory or practical courses to fulfill the minimum credit requirement.
h) The students may be allowed to take maximum of two subjects per semester pertaining to their minor
i) Students shall not be permitted to register for minor degree after completion of VI semester.
j) The students are permitted to opt for only a single minor course in his/her entire tenure of B.Tech (Engineering)
k) The students registered for B.Tech (Honors) shall not be permitted to register for minor
l) The student is not permitted to take the electives courses from the parent department to fulfill the minimum

6) Credits requirement

a) A Student will be eligible to get minor along with major degree engineering, if he/she completes an additional 18 credits. These may be acquired either in offline or online like NPTEL/SWAYAM etc.,
b) Additional credits shall also be acquired through NPTEL Courses, which shall be domain specific, with a minimum duration of 8 / 12 / 16 weeks (2/3/4 credits) as recommended by the

Board of studies.

c) Students shall produce a certificate issued by the NPTEL/SWAYAM etc., conducting agency as a proof of credit attainment
d) The colleges offering minor courses shall be ready to teach the courses in offline at their college in the concerned departments. Curriculum and the syllabus of the courses shall be approved by the Board of Studies
e) After successful completion of all major and minor courses with specified CGPA the University will award both major and minors

7) Procedure to Apply for Minors degree

a) The department offering the minor will announce specialization and courses before the start of the session.
b) The interested students shall apply through the HoD of his/her parent department.
c) The concerned department will announce the list of the selected students for the minor.
d) The whole process should be completed within one week before the start of every session.
e) Selected students shall be permitted to register the courses for minor.

8) To Join in Minors Program

a) Each department offering the minor will submit the final list of selected students to the principal.
b) The selected students shall submit a joining letter to the Principal through the concerned HoD offering the minor. The student shall inform same to the HoD of his/her parent department.
c) Both parent department and department offering minor shall maintain the record of student pursing the minor
d) With the approval of Principal and suggestion of advisor, students can choose courses from the approved list and shall register the courses within a week as per the conditions laid down in the structure for the minor.
e) Each department shall communicate the minor courses registered by the students to the time table drafting committee and accordingly time table will be drafting. Time table drafting committee shall see that no clash in time tables.

9) Procedure for Monitoring the Progress of the Scheme

The students enrolled in the minor courses will be monitored continuously at par with the prevailing practices and examination standards. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

10) Allocation of seats for Minors degree

a) The university /institute/ colleges will notify the number of the seats for minor in the concerned department well in advance before the start of the semester

b) Total number of seats offered for a minor programme shall be a maximum of 60 (based on merit).

c) The list of the electives for minor will be offered from the list of running majors in the concerned subjects.

d) There is no fee for registration of subjects for minor degree programme offered in off line at the respective colleges.

11) Examinations

a) The examination for the minor courses offered in offline shall be conducted along with regular B.Tech programme.

b) The examinations (internal and external) and evaluation procedure of minor courses offered in offline is similar to regular B.Tech courses.

c) A separate transcript shall be issued for the minor subjects passed in each semester

d) It may be noted that both major and minor courses (from IV Semester to VII Semester) are to be completed in 4 Years for Regular students and 3 Years for lateral entry admitted students.

e) Examination Fees: Examination Fees will be as per the institute norms

f) For awarding the class, CGPA obtained in Minor Degree only will be considered.

g) For awarding the Minor, obtained credits only will be considered.

College offering B.Tech Minors Degree in the following Specialization, and the student can take any one of Specialization to get B.Tech Minors by satisfying eligibility criteria.

S.No	Specialization	Offered By	Minors (For Students)
1	Robotics and Automation System	MECH	CSE/CSE(AIML)/CSE(DS)/ECE/EEE

SPECIALIZATION-1: ROBOTICS AND AUTOMATION SYSTEM

S.No	Subject Code	Year of Study	Subject	L	T	P	C
1	R24DEM201	II-II	Fundamentals of Robotics	3	0	0	3
2	R24DEM302	III-I	Robotics Drives and Sensors	3	0	0	3
3	R24DEM303	III-II	Automation in Manufacturing	3	0	0	3
4	R24DEM404	IV-I	Industrial Automation System	3	0	0	3
5	R24DEM405	---	NPTEL/MOOC COURSE-1	0	0	0	3
6	R24DEM406	---	NPTEL/MOOC COURSE-2	0	0	0	3
			Total	12	0	0	18

Fundamentals of Robotics

Course Title: Fundamentals Of Robotics	Course Code: R24RAS201
Teaching Scheme(L:T:P): 3:0:0	Credits:3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Prerequisites Engineering Mathematics, Physics, Engineering Graphics / CAD, Control Systems	

Course Overview:

1. Fundamentals of Robotics involve the study of robot design, control, sensing, and programming.
2. It integrates mechanical, electrical, and computer engineering to build intelligent machines
3. Key topics include kinematics, dynamics, sensors, actuators, and control systems.
4. Robotics is applied across industries for automation, precision tasks, and intelligent interaction.

Course Objectives:

1. To familiarize the evolution and anatomy of robot and its coordinate frames
2. To enhance the student's skills in perform kinematic analysis of robot systems
3. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
4. To impart the student with some knowledge and analysis skills associated with robot dynamics and trajectory planning.
5. To develop the ability to analyse and design the articulated systems and their applications and skills associated with robot control.

Course Outcomes:

Course Code	Course Outcomes	PO1	PO2	PO3	PO5	PO6	PO10	PO11	PSO1	BT
R24RAS201.1	Understand the basic components of robots and the types of robots and robot grippers.	3	2	2	0	0	1	0	3	**L1, L2**
R24RAS201.2	Comprehend and interpret various aspects relating to robot kinematics and dynamics.	3	2	0	2	0	0	0	3	**L2**
R24RAS201.3	Analyse and demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational work-space characteristics.	3	0	2	3	1	1	0	2	**L3**
R24RAS201.4	Understand the robot dynamics and trajectory planning.	2	0	2	2	0	2	1	0	**L3, L4**

R24RAS201.5	Describe and judge the use of robotics in industrial applications and gain skills associated with robot control systems.	0	0	3	3	2	3	0	2	**L3, L5**

SYLLABUS

UNIT- I

Introduction: Evolution of robots and robotics, Laws of robotics, Progressive advancement in robots, Robot anatomy, Human arm characteristics, Design and control issues, Manipulation and control, Sensors and vision, Programming robots, The future prospects.
Coordinate frames and transformations: Coordinate frames, Description of objects in space, Transformation of vectors, inverting a Homogeneous transform, Fundamental rotation Matrices.

CO's: CO1

Self Learning Topics: Understand robot configuration, structures, basic components, work space and generations of robots

UNIT- II

Direct kinematics: Mechanical structure and notations, Description of links and joints, Kinematic modeling of the manipulator, Denair- Hardenberg notation, Kinematic relationship between adjacent links, Manipulator transformation Matrix.

CO's: CO2

Self Learning Topics: Understand robot configuration, structures, basic components, work space and generations of robots Analyse the manipulator kinematics with reference to degrees of freedom. Solve numerical problems in transformations.

UNIT- III

Inverse kinematics: Manipulator workspace, Solvability of inverse kinematic model, Solution techniques, closed form solution
Manipulate or differential motion and statics: Linear and angular velocity of a rigid body, Relationship between transformation matrix and angular velocity, Mapping velocity vector, Velocity propagation along links, Manipulator Jacobian, Jacobian inverse, Jacobian singularities, Static analysis.

CO's: CO3

Self Learning Topics: Demonstrate an ability to obtain the Jacobian matrix anduseitto identify singularities.

UNIT - IV

Robot Dynamics: Langrangian mechanics, Two degree of freedom manipulator-dynamic model, Langrange-Euler formation, Newton-Euler formulation, comparison of Lagrange-Euler and Newton- Euler formulations, Inverse dynamics.
Trajectory planning and generation: Definitions and planning tasks, Joint space techniques, Cartesian space techniques, Joint-Space versus Cartesian Space trajectory planning.

CO's: CO4

Self Learning Topics: Demonstrate an ability to generate joint trajectory form option planning

UNIT V

Control of manipulators: Open and close loop control, The manipulator control problem, line are control schemes, Characteristics of second-order linear systems, Linear second-order SISO model of a manipulator joint, Joint actuators, Partitioned PD control scheme, PID control scheme,

Computed Torque control, Force control of robotic manipulators, Description of fore-control tasks, Force-control strategies, Hybrid position/force control, Impedance force/torque control.
Robot Applications: The meaning of sensing, Sensors in robotics, Kinds of sensors used in robotics, Robotic vision, Industrial applications of vision-controlled robotic systems, Process of imaging, Architecture of robotic vision systems, Image acquisition, Description of other components of vision systems, Image representation, Image processing.

CO's: CO5

Self Learning Topics: Utilize the concept of image processing and analysis.

Text Books:

1. D. Nagrath and Mittal, "RoboticsandControl", TataMcGraw-Hill, 2003.
2. Spong and Vidhya sagar, "RobotDynamicsandControl", JohnWileyandsons, 2008.
3. Fu.K.S, Gonzalez, R.C., Lee, C.S.G,"Robotics,control,sensing,VisionandIntelligence", McGraw Hill International, 1987.

References:

1. HarryAsada andSlottine"RobotAnalysisandControl", WileyPublications, 2014.
2. SKSaha,"Introductionto Robotics",2ndedition,TMH, 2013.

Robotics Drives And Sensors

Course Title: Robotics Drives And Sensors	Course Code: R24RAS302
Teaching Scheme(L:T:P): 3:0:0	Credits:3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Prerequisites: Kinematics and Dynamics of Machines, Basic Electrical and Electronics Engineering, Physics	

Course Overview:

This course explores the key components that enable robot movement and environmental perception. Students will learn about various types of actuators, motors, and drive mechanisms used in robotics. It also covers a wide range of sensors, including proximity, vision, and force sensors, along with their integration. Emphasis is placed on control strategies, sensor fusion, and real-world applications in automated systems.

Course Objectives:

1. Focuses on fundamental concepts of robot drive systems.
2. Focuses on types and working of robot drive systems.
3. Fundamentals electrical motor sand sensors.
4. Understanding different types of sensors and their working.
5. Understanding miscellaneous sensors and their workings.

Course Outcomes:

Course Code	Course Outcomes	PO1	PO2	PO3	PO5	PO6	PO10	PO11	PSO1	BT
R24RAS302.1	Understand the different drive system.	3	2	2	0	0	1	0	3	**L1, L2**
R24RAS302.2	Understand the hydraulic and pneumatic drive system.	3	2	0	2	0	0	0	3	**L2**
R24RAS302.3	Understand electrical drive system for robot application.	3	0	2	3	1	1	0	2	**L3**
R24RAS302.4	Understand the different sensors and their working.	2	0	2	2	0	2	1	2	**L3, L4**
R24RAS302.5	Understand the advance and vision sensors.	0	0	3	3	2	3	0	2	**L3, L5**

SYLLABUS

UNIT- I

Drive Mechanisms: Objectives, motivation, open loop control, closed loop control with velocity and position feedback.
Types of Drive Systems: Lead Screws, Ball Screws, Chain and linkage drives, Belt drives, Gear Drives, Precision gear boxes, Harmonic drives, Cyclo-speed reducers.

CO's: CO1

Self Learning Topics: Summarizing the Harmonic drives, Cyclo-speed drive systems.

UNIT- II

Hydraulic Drives: Introduction, Requirements, Hydraulic piston and transfer valve, hydraulic circuit incorporating control amplifier, hydraulic fluid considerations, hydraulic actuators Rotary and linear actuators. Hydraulic components in robots.
Pneumatic Drives: Introduction, Advantages, Pistons-Linear Pistons, Rotary pistons, Motors-Flapper motor, geared motor, Components used in pneumatic control. Pneumatic proportional controller, pneumatically controlled prismatic joint.

CO's: CO2

Self Learning Topics: Estimating the pneumatic drive systems.

UNIT- III

Electric Drives: Introduction, Types, DC electric motor, AC electric motor, stepper motors, half step mode operation, micro step mode. Types of stepper motors, direct drive actuator
Sensors: Introduction: An Introduction to sensors and transducers, History and definitions, Smart Sensing, AI sensing, Need of sensors in Robotics.

CO's: CO3

Self Learning Topics: Summarizing the basic concepts of sensors**.**

UNIT - IV

Sensors in Robotics: Position sensors - optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors - Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors

CO's: CO4

Self Learning Topics: Estimating contact and non-contact sensors

UNIT V

Miscellaneous Sensors: Different sensing variables – smell, Heat of Temperature, Humidity, Light, Speech or Voice Recognition Systems, Telepresence and related technologies.
Vision Sensors: Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system, End effect or camera Sensor.

CO's: CO5

Self Learning Topics: Relating the advanced sensors

Text Books:

1. D FrancisN-NagyAndrasSiegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
2. RichardD.Klafter,Thomas.A,Chmielewski,MichaelNegin,RoboticsEngineeringan,Inte

grated Approach, Prentice Hall of India Pvt. Ltd., 1989

3. P.A.JanakiRaman, Robotics and Image Processing an Introduction, Tata McGrawHillPblishing Company Ltd., 19954.

References:

1. K.Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, Prentice Hall of India Pvt.Ltd. 2001.
2. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 1999.
3. Sensor Technology Handbook by Jon S. Wilson.
4. N.L.Buck&T.G.Buckwith, Mechanical measurement.

Automation In Manufacturing

Course Title: Automation In Manufacturing	Course Code: R24RAS303
Teaching Scheme(L:T:P): 3:0:0	Credits:3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Prerequisites: Manufacturing Processes & Systems, Control Systems and Mechatronics, CAD/CAM	

Course Overview:

This course introduces the principles and technologies of automation used in modern manufacturing systems. Topics include industrial control systems, robotics, PLCs, sensors, and automated production lines. Students will analyze and design automated processes for increased efficiency and quality. Real-world applications and case studies are used to bridge theory and industry practices.

Course Objectives:

1. Lower Cost and Improve Time-to-Market
2. Automation investment life-cycle analysis
3. Empowered teams of talented employees
4. Partnering with automation suppliers
5. On-line process analysis
6. Procedural process control
7. Information integration and data ware housing

Course Outcomes:

Course Code	Course Outcomes	PO1	PO2	PO3	PO5	PO6	PO11	PSO1	BT
R24RAS303.1	Illustrate the basic concepts of automation in machine tools.	3	2	2	0	0	0	3	L1, L2
R24RAS303.2	Analyze various automated flow lines, Explain assembly systems and line balancing methods.	3	2	0	2	0	0	3	L2
R24RAS303.3	Describe the importance of automated material handling and storage systems.	3	0	2	3	1	0	2	L3
R24RAS303.4	Interpret the importance of adaptive control systems, automated inspection systems.	2	0	2	2	0	1	0	L3, L4
R24RAS303.5	Use automation principles for manufacturing industrial applications.	0	0	3	3	2	0	2	L3, L5

SYLLABUS

UNIT- I

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

CO's: CO1

Self Learning Topics- Industry 4.0, Smart Manufacturing, Robotics in Automation**.**

UNIT- II

Introduction to Material Handling: Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar technology, other ADC technologies

CO's: CO2

Self Learning Topics- Advanced Sensor Technologies, Sensor Fusion, Sensor Networks

UNIT- III

Manual Assembly Lines – Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, , Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines Considerations in assembly line design.

CO's: CO3

Self Learning Topics- Embedded Systems, Power Electronics, Servo and Stepper Motors

UNIT - IV

Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

CO's: CO4

Self Learning Topics- Advanced Actuation Systems, Hydraulic and Pneumatic Systems, FEA and MBD

UNIT V

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems-Parts Delivery

System at Work Stations, MultiStation Assembly Machines, Single Station Assembly Machines, Partial Automation.

CO's: CO5

Self Learning Topics- Smart Pneumatic Systems, CNC Programming, Hybrid Manufacturing

Text Books:

1. Boltan, W., "Mechatronics: electronic control systems in mechanical and electrical engineering", Longman, Singapore, 1999.
2. Groover, M.P., "Automation, Production Systems, and Computer-Integrated Manufacturing", Prentice Hall, 2001.
3. Gaonkar, R.S., "Microprocessor architecture, programming, and applications with the 8085", Penram International Publishing (India), Delhi, 2000.

References:

1. Regtien, P. P. L., "Sensors for mechatronics", Elsevier, USA, 2012.
2. Parr, A. A., "Hydraulics and pneumatics", Elsevier, 1999.

Industrial Automation System

Course Title: Industrial Automation System	Course Code: R24RAS304
Teaching Scheme(L:T:P): 3:0:0	Credits:3
Type of Course: Lecture	Total Contact Periods:3
Continuous Internal Evaluation: 30 Marks	Semester End Exam: 70 Marks
Prerequisites: Manufacturing Processes & Systems, Hydraulics, Electrical and Electronics Basics	

Course Overview:

This course introduces the principles and components of industrial automation, including PLCs, sensors, actuators ,and control systems.
Students will learn how to design, program, and troubleshoot automated manufacturing processes.
Emphasis is placed on real-world applications, safety standards, and system integration.
Hands-on labs and projects provide practical experience with industry-standard tools and technologies.

Course Objectives:

1. Understand the importance of basic concepts of automation in machine tools.
2. Learn how to select various automated flow lines, Explained assembly systems and line balancing methods.
3. Study the use of empowered teams of talented employees.
4. Learn about the importance of automated material handling and storage systems.
5. Study the use of adaptive control systems, automated inspection systems.

Course Outcomes:

Course Code	Course Outcomes	PO1	PO2	PO3	PO5	PO6	PO11	PSO1	BT
R24RAS404.1	Explain the Principles and strategies of automation, Basic elements of an automated system.	3	3	2	0	0	0	3	**L1, L2**
R24RAS404.2	Describe working and Types of material handling equipment, Design of the system, Conveyor system, Automated guided vehicle system.	3	2	0	3	0	0	3	**L2**
R24RAS404.3	Analyze various automated flow lines, Explain assembly systems and line balancing methods.	3	0	2	3	1	0	2	**L3**
R24RAS404.4	Summarize the computer based industrial automation- importance of automated material handling and storage systems.	2	0	3	2	0	1	0	**L3, L4**

R24RAS404.5	Use the importance of adaptive control systems, automated inspection systems.	0	0	3	3	2	0	2	**L3, L5**

SYLLABUS

UNIT- I

Introduction: Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Analysis of transfer lines without storage, Automated flow lines with storage buffers. **CO's: CO1**

Self Learning Topics- Industry 4.0, Smart Manufacturing, Robotics in Automation.

UNIT- II

Material handling and identification technologies -Overview of material handling systems, Types of material handling equipment, Design of the system, Conveyor system, Automated guided vehicle system, Automated storage systems, Interfacing handling and storage with manufacturing, Overview of Automatic Identification Methods.

CO's: CO2

Self Learning Topics- Automated storage systems Technologies, Conveyor system.

UNIT- III

Automated Manufacturing Systems-Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system (FMS), FMS and its planning and implementation, Automated assembly system – design and types of automated assembly systems, Analysis of multi station and single station assembly machine. **CO's: CO3**

Self Learning Topics- Embedded empowered, Flexible manufacturing system.

UNIT - IV

Automation in process industries: Introduction to computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS) and supervisory control and data acquisition (SCADA) based architectures. SCADA for process industries includes understanding of RTUs, Pumping stations, Evacuation processes, Mass Flow Meter sand other flowmeters, Leak-flow studies of pipelines, Transport Automation. Programmable Logic Controller (PLC)- Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Design of alarm and inter locks Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs, Integrating Process safety PLC and DCS, Application of international standards in process safety control.

CO's: CO4

Self Learning Topics- Advanced Actuation Systems, Hydraulic and Pneumatic Systems.

UNIT V

Distributed Control System- Local Control Unit(LCU)architecture, LCU Process Interfacing Issues, Block diagram and Overview of different LCU security design approaches, Networking of DCS. Introduction to communication protocols- Profibus, Field bus, HART protocols.

Data gathering, Data analytics, Real-time analysis of data stream from DCS, Historian build, Integration of business inputs with process data, Leveraging RTU (as different from PLCs and DCS) CU security design approaches, Networking of DCS.

CO's: CO5

Self Learning Topics- Real-time analysis of data stream, Hybrid Manufacturing.

Text Books:

1. M.P.Groover,"Automation, Production Systems and Computer Integrated Manufacturing", 5 th Edition, Pearson Education, 2009.
2. JohnW.WebbandRonaldA.Reis,"ProgrammableLogicControllers:Principlesand Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
3. KrishnaKant,"Computer-BasedIndustrialControl",2ndEdition,PrenticeHall,New Delhi, 2011
4. FrankD. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016

References:

1. CurtisD.Johnson,"ProcessControlInstrumentationTechnology",8th Edition,Pearson New International, 2013.
2. Lukas M.P, " Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
3. N.Viswanandham,Y.Narahari,"PerformanceModelingofAutomatedManufacturing Systems", 1st Edition, 2009.
4. https://nptel.ac.in/syllabus/108108098/

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech-Mechanical Engineering **Regulation**-R24

III Year I Semester- Course Structure

S. No	Category	Course Code	Course Title	Hours per Week			
				L	T	P	C
1	PC	R24MEPC13	Machine tools & Metrology	3	0	0	3
2	PC	R24MEPC14	Thermal Engineering	3	0	0	3
3	PC	R24MEPC15	Design of Machine Members	3	0	0	3
4	PE-1	R24MEPE1.1 R24MEPE1.2 R24MEPE1.3 R24MEPE1.4 R24MEPE1.5	**Professional Elective-1** 1. Unconventional Machining Process 2. Additive Manufacturing 3. Tribology 4. Hydrogen Fuel Cell Technology 5. Industrial Hydraulic & Pneumatics 8 /12 week MOOCS /SWAYAM/ NPTEL Course recommended by BoS	3	0	0	3
5	OE-1		**OE offered by other departments**	3	0	0	3
6	PC Lab-1	R24MEPC16	Machine tools & Metrology Lab	0	0	3	1.5
7	PC Lab-2	R24MEPC17	Thermal Engineering Lab	0	0	3	1.5
8	SC	R24MESC03	Drone Technology & Instrumentation and Control systems Lab	0	0	2	1
9	HS	R24HS08	Employability skills -1 Competitive Coding	0	0	2	1
10	Internship	R24IN01	Industrial Evaluation/ Community Service Internship	2	0	0	2
11	MC	R24MC06	Technical paper writing & IPR	2	0	0	0
			Total	**19**	**00**	**10**	**22**

Category	Courses	Credits
PC-Professional Core Courses	5	12
PE- Professional Elective	1	3
OE-Open Elective	1	3
Internship	1	2
SC- Skill Enhancement course	1	1
HS- Humanities and Management Sciences Courses	1	1
MC-Mandatory Course	1	0
Total	**11**	**22**

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech-Mechanical Engineering **Regulation**-R24

III Year II Semester- Course Structure

S. No	Category	Course Code	Course Title	Hours per Week L	T	P	C
1	PC	R24MEPC18	Theory of Machines	3	0	0	3
2	PC	R24MEPC19	Heat Transfer	3	0	0	3
3	PE-2	R24MEPE2.1 R24MEPE2.2 R24MEPE2.3 R24MEPE2.4 R24MEPE2.5	**Professional Elective-2** 1. Cryogenics 2. Nano Technology 3. Product Design & Development 4. Thermal Management Of Electronics Systems 5. Operations Management 8 /12 week MOOCS /SWAYAM/ NPTEL Course recommended by BoS	3	0	0	3
4	PE-3	R24MEPE3.1 R24MEPE3.2 R24MEPE3.3 R24MEPE3.4 R24MEPE3.5	**Professional Elective-3** 1. Instrumentation & Control Systems 2. Non Destructive Evaluation 3. Smart Materials 4. Automobile Engineering 5. Automation in Manufacturing 8 /12 week MOOCS /SWAYAM/ NPTEL Course recommended by BoS	3	0	0	3
5	OE-2		**OE offered by other departments**	3	0	0	3
6	PC Lab-1	R24MEPC20	Theory of Machines Lab	0	0	3	1.5
7	PC Lab-2	R24MEPC21	Heat Transfer Lab	0	0	3	1.5
8	SC	R24MESC04	Artificial Intelligence and Machine Learning Lab	0	0	2	1
9	HS	R24HS09	Employability Skills-2 Advanced Aptitude and Communication Skills	0	0	2	1
10	MC	R24MC05	Constitution of India	2	0	0	0
			Total	17	0	10	20
			Mandatory Industry Internship of 08 weeks duration during summer vacation				

Category	Courses	Credits
PC-Professional Core Courses	4	9
PE- Professional Elective	2	6
OE-Open Elective	1	3
SC- Skill Enhancement course	1	1
HS- Humanities and Management Sciences Courses	1	1
MC-Mandatory Course	1	0
Total	**10**	**20**

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech-Mechanical Engineering **Regulation**-R24

IV Year I Semester- Course Structure

S. No	Category	Course Code	Course Title	Hours per Week			
				L	T	P	C
1	PC	R24MEPC22	Finite Element Methods	3	0	0	3
2	PC	R24MEPC23	Hybrid & E- Vehicles	3	0	0	3
3	Management Course-II	R24HS12	Managerial skills for Engineers	2	0	0	2
4	PE-4	R24MEPE4.1 R24MEPE4.2 R24MEPE4.3 R24MEPE4.4 R24MEPE4.5	**Professional Elective-4** 1. Optimization Techniques 2. Advanced Materials 3. Supply Chain Management 4. Refrigeration & Air Conditioning 5. Smart Manufacturing 8 /12 week MOOCS /SWAYAM/ NPTEL Course recommended by BoS	3	0	0	3
5	OE-3		**OE offered by other departments**	3	0	0	3
6	SC	R24MESC05	Computer Aided Analysis & Mechatronics Lab	0	0	2	1
7	HS	R24HS11	Employability Skills-3 Corporate Readiness for IT	0	0	2	1
8	Internship	R24IN02	Evaluation of Industry Internship (Done during III-II Summer vacation- 8 weeks)	0	0	0	2
9	MC	R24MC07	Value Education	2	0	0	0
Total				**16**	**00**	**04**	**18**

Category	Courses	Credits
PC-Professional Core Courses	2	6
PE- Professional Elective	1	3
OE-Open Elective	1	3
HS- Humanities and Management Sciences Courses	2	3
SC- Skill Enhancement course	1	1
Internship	1	2
MC-Mandatory Course	1	0
Total	**09**	**18**

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B.Tech-Mechanical Engineering **Regulation**-R24

IV Year II Semester- Course Structure

S. No	Category	Course Code	Course Title	Hours per Week L	T	P	C
1	PE-5	R24MEPE5.1 R24MEPE5.2 R24MEPE5.3 R24MEPE5.4 R24MEPE5.5	**Professional Elective-5** 1. Power Plant Engineering 2. Industrial Robotics 3. Production Planning & Control 4. Design for Manufacturing, 5. Operations Research 8 /12 week MOOCS /SWAYAM/ NPTEL Course recommended by BoS	3	0	0	3
2	OE-4		**OE offered by other departments** 8 /12 week MOOCS /SWAYAM/ NPTEL Course recommended by BoS	3	0	0	3
3	PR	R24PR01	Internship & Project Work	0	0	24	12
Total				**6**	**0**	**24**	**18**

Category	Courses	Credits
PE- Professional Elective	1	3
OE-Open Elective	1	3
Internship & Project Work	1	12
Total	**3**	**18**

Note:

1. **Student need to do at least ONE MOOC/NPTEL Course (of 3 credits out of 160 credits) to meet the mandatory requirement (11th criteria, as per R24 Regulations); they are allowed to register one semester in advance.**
2. **Open Elective can be Inter Department Disciplinary Course, Emerging Courses or MOOC. Final decision will be taken by the BoS.**

OPEN ELECTIVES

Course Code	Course Name	L	T	P	C
R24MEOE01	Principles of Robotics	3	0	0	3
R24MEOE02	Green Manufacturing				
R24MEOE03	Electrical & Hybrid Vehicles				
R24MEOE04	Industrial Safety				
R24MEOE05	Introduction to CAD				
R24MEOE06	Waste to Energy Conversion				
R24MEOE07	Hydrogen fuel cell Technology				
R24MEOE08	Industrial Engineering and Management				
R24MEOE09	Principles of 3D Printing Technology				
R24MEOE10	Non-Conventional Energy Resources				
R24MEOE11	Automation In Manufacturing				
R24MEOE12	Operations Research				
R24MEOE13	Sustainable Energy Technologies				
R24MEOE14	Energy Conservation Management				
R24MEOE15	Total Quality Management				
R24MEOE16	Nano Materials				

Note: Students may opt for any of the above Open Electives or an 8/12-week SWAYAM/ NPTEL MOOC Course, duly approved by the Chairman, BoS and Communicated to the Dean of Academics.

MACHINE TOOLS AND METROLOGY

Course Title: **MACHINE TOOLS AND METROLOGY**	**YEAR -III SEM-I**
Teaching Scheme (L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code: R24MEPC13**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: Basic knowledge of manufacturing processes, engineering drawing, and material properties.	

Course Objectives:

1. To interpret the fundamental principles in material removal processes.
2. To apply the fundamentals and principles of metal cutting to machining process using lathes, milling machines, grinding machines, drill presses, Computer Numerical Control machines etc
3. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
4. To develop knowledge and importance of metal cutting parameters and demonstrate the fundamentals of machining processes and machine tools.
5. To analyze the concepts of finishing processes and the system of limits and fits.
6. To illustrate the concepts of surface roughness and optical measuring instruments

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Interpret the concepts of machining processes.	3	2	-	-	-	2	L2 (Understand)
Apply the principles of lathe, shaping, slotting and planning machines.	3	3	2	-	-	3	L3 (Apply)
Apply the principles of drilling, milling and boring processes.	3	3	2	-	-	3	L3 (Apply)
Analyze the concepts of finishing processes and the system of limits and fits.	3	3	-	2	-	2	L4 (Analyze)
Illustrate the concepts of surface roughness and optical measuring instruments.	2	2	-	2	-	2	**L2 (Understand)**

SYLLABUS

UNIT–I

FUNDAMENTALS OF MACHINING: Elementary treatment of metal cutting theory – element of cutting process – Single point cutting tools, nomenclature of single point cutting tool, tool signature, tool angles, mechanism of metal cutting, types of chips and chip formation – built up edge and its effects, chip breakers, mechanics of orthogonal and oblique cutting Merchant's force diagram, cutting forces, velocity ratio, cutting speeds, feed, depth of cut, tool life, Taylor's tool life equation, simple problems – Tool wear, tool wear mechanisms, heat generation in metal cutting, coolants, machinability, economics of machining, tool materials and properties

UNIT–II

LATHE MACHINES: Introduction- types of lathe – Engine lathe – principle of working – construction – specification of lathe – work holders and tool holders – accessories and attachments – lathe operations – taper turning methods and thread cutting – drilling on lathes – cutting speed and feed-depth of cut.

SHAPING, SLOTTING AND PLANNING MACHINES: Introduction – principle of working – principle parts – specifications – operations performed – slider crank mechanism – machining time calculations.

UNIT –III

DRILLING & BORING MACHINES: Introduction – construction of drilling machines – types of drilling machines – principles of working – specifications- types of drills – geometry of twist drill – operations performed –cutting speed and feed – machining time calculations – Boring Machines – fine Boring Machines – jig boring machines – deep hole Drilling Machines.

MILLING MACHINES: Introduction – principle of working – specifications – milling methods – classification of Milling Machines –types of cutters – geometry of milling cutters – methods of indexing, accessories to milling machines – cutting speed and feed – machining time calculations

UNIT–IV

FINISHING PROCESSES: Introduction – theory of grinding – classification of grinding machines- cylindrical and surface grinding machines- tool and cutter grinding machines- different types of abrasives- bonds, specification and selection of a grinding wheel-lapping, Honing & Broaching operations- comparison to grinding.

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, different types of fits -Unilateral and bilateral tolerance system, hole and shaft basis systems interchangeability, deterministic & statistical tolerances, selective assembly- International standard system of tolerances, selection of limits and tolerances for correct functioning, simple problems related to limits and fits, Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges – inspection of gauges

UNIT–V

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, simple problems – method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope, Autocollimators, Optical projector, Optical flats-working construction, merits, demerits and their uses. optical comparators

TEXTBOOK:

1. Manufacturing Processes / JP Kaushish/ PHI Publishers-2 nd Edition
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
3. Engineering Metrology – R.K. Jain/Khanna Publishers

REFERENCES:

1. Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
2. Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).
3. Production Engineering/K.C Jain & A.K Chitaley/PHI Publishers
4. Technology of machine tools/S.F.Krar, A.R. Gill, Peter SMID/ TMH
5. Manufacturing Processes for Engineering Materials-Kalpak Jian S & Steven R Schmid/Pearson Publications 5 th Edition

THERMAL ENGINEERING

Course Title: THERMAL ENGINEERING	**YEAR -III SEM-I**
Teaching Scheme (L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEPC14**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: Basics of Thermodynamics and Fluid Mechanics.	

Course Objectives:

The students will acquire the knowledge

1. To interpret the different processes in air-standard cycles and differences between Air Standard and Actual Cycles
2. To interpret the basic principles of vapour power cycles
3. To illustrate combustion phenomenon and identify the functions of boilers and draught systems and evaluate their performance.
4. To demonstrate the performance of an IC engine and gas turbine based on the performance parameters.
5. To summarize the classification and basic principles of compressors.

Course Outcomes:

The students will be able to

1. Interpret the different processes in air-standard cycles and differences between Air Standard and Actual Cycles
2. Analyze the basic principles of vapour power cycles
3. Illustrate the combustion phenomenon and identify the functions of boilers and draught systems and evaluate their performance.
4. Analyze the performance of an IC engine and gas turbine based on the performance parameters.
5. Illustrate the classification and basic principles of compressors.

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	1					1		3
CO2	3	3	1	2	1	2					1		3
CO3	3	3	2	2	2	3	1				1		3
CO4	3	3	2	3	2	2				1	1	1	3
CO5	3	2	1	1	2	1					1	1	3

SYLLABUS

UNIT – I

Air standard Cycles: Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton cycle

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down -Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT – II

I. C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of Wankle engine, principles of supercharging and turbo charging.

Measurement, Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart

UNIT III

VAPOUR POWER CYCLES: Carnot, Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.

BOILERS: Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – Draught: classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.

UNIT – IV

STEAM NOZZLES: Function of a nozzle – applications - types, velocity coefficient, condition for maximum discharge, critical pressure ratio, nozzle efficiency.

TURBINES: Classification of steam turbines -impulse turbine and reaction turbine - compounding in turbines - velocity diagrams in impulse and reaction turbines, efficiency, degree of reaction.

STEAM CONDENSERS: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump, cooling water requirement

UNIT – V

COMPRESSORS – Introduction, Classification

Reciprocating: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression.

Rotary (Positive displacement type)

Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

Rotary (non positive displacement type)

Centrifugal compressors: Mechanical details and principle of operation slip factor, power input factor, pressure coefficient and adiabatic coefficient.

TEXTBOOK:

1. I.C. Engines - V. Ganesan- Tata McGraw Hill Publishers
2. Gas Turbines – V.Ganesan – Tata McGraw Hill Publishers

REFERENCES:

1. Thermal Engineering - Mahesh Rathore- McGraw Hill publishers
2. I.C.Engines–AppliedThermosciences–C.R.Ferguson&A.T.Kirkpatrick-2ndEdition Wiley Publishers
3. I.C. Engines - J.B.Heywood /McGrawHIll.
4. Heat engines, Vasandani & Kumar - Thermal publications
5. Gas Turbine Theory – HIH Saravanamuttoo, Cohen, Rogers –Pearson Publishers

DESIGN OF MACHINE MEMBERS

Course Title: DESIGN OF MACHINE MEMBERS	**YEAR -III SEM-I**
Teaching Scheme (L:T:P): 3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code: R24MEPC15**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: To understand the Knowledge of Engineering Mechanics, Strength of Materials, and Theory of Machines.	

Course Objectives:

1. Provide an introduction to design of machine elements.
2. Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
3. Explain design procedures to different types of joints.
4. Teach principles of clutches and brakes and design procedures.
5. Instruct different types of bearings and design procedures.

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**PO11**	**PS01**	**BT LEVEL**
Estimate safety factors of machine members subjected to static and dynamic loads	3	3	2	2	-	3	(L4) Analyze
Design the fasteners subjected to variety of loads.	3	3	3	2	-	3	(L6) Create
Select of standard machine elements such as keys, shafts, couplings, springs and bearings	3	2	2	1	-	3	(L3) Apply
Design of clutches, brakes and springs.	3	3	3	2	-	2	(L6) Create
Design of bearing and gears.	3	3	3	2	-	2	(L6) Create

SYLLABUS

UNIT–I

Introduction, Design for Static and Dynamic loads

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

UNIT–II

Design of Bolted and Welded Joints

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, gasketed joints and eccentrically loaded bolted joints

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. Eccentrically loaded welded joints.

UNIT –III

Power transmission Shafts and Couplings

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors**.**

Couplings: Design of flange and bushed pin couplings, universal coupling.

UNIT–IV

Design of Clutches, Brakes and Springs

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

Springs: Design of helical compression, tension, torsion and leaf springs.

UNIT–V

Design of Bearings and Gears

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

Design of Spur Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

TEXTBOOK:

1. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004.
2. V.B.Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.
3. Dr. N. C. Pandya &Dr. C. S. Shah, Machine design, 17/e, Charotar Publishing House Pvt. Ltd, 2009.

REFERENCES:

1. R.K. Jain, Machine Design, Khanna Publications, 1978.
2. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson Education), 2013.
4. K. Mahadevan & K. Balaveera Reddy, Design data handbook, CBS Publications, 4/e, 2018.

Online Learning Resources:

- **https://www.yumpu.com/en/document/view/18818306/lesson-3-course-name design-ofmachine-elements-1-nptel**
- **https://www.digimat.in/nptel/courses/video/112105124/L01.html**
- **https://dokumen.tips/documents/nptel-design-of-machine-elements-1.html**
- **https://archive.nptel.ac.in/courses/112/105/112105125/**
- **https://www.coursera.org/learn/machine-design1**

MACHINE TOOLS AND METROLOGY LAB

Course Title: MACHINE TOOLS AND METROLOGY LAB	**YEAR -III SEM-I**
Teaching Scheme(L:T:P): 0:0:3	**Credits:1.5**
Type of Course: PRACTICAL	**Course Code: R24MEPC16**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Basic knowledge of Manufacturing Engineering, Engineering Metrology, and Engineering Drawing.	

Course Objectives:

1. To interpret the working principles of various machines viz lathe, Drilling, milling, shaping.
2. To illustrate the usage of CNC in Lathe and Milling machines.
3. To learn about basic measuring instruments vernier callipers, screw gauge, vernier height gauge.
4. To learn the measurement of the angle and taper by Bevel protractor, Sine bar, etc.
5. To learn about Mechanical parameter measuring systems and different alignment techniques.
6.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT LEVEL**
Perform step, taper turning, knurling and threading operations on lathe.	3	2	2	3	1	3	L3
Practical exposure on Flat Surface machining, Shaping, Slotting, Milling and grinding operations.	3	2	2	3	1	3	L2
Develop programs on CNC lathe and Milling machines.	3	3	3	3	2	3	L4
Apply the procedures to measure length, width, depth, bore diameters, external tapers, tool angles, and surface roughness by using different instruments.	3	3	2	3	2	3	L3
Demonstrate knowledge of different machine tools used in machine shops.	2	2	1	2	1	2	L2

SYLLABUS

Part A- List of Experiments

Introduction of general-purpose machines -Lathe, drilling machine, Milling machine, Shaper, Planning machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.

1. To perform Step turning and taper turning on lathe machine
2. To perform Thread cutting and knurling on lathe machine.
3. To perform spur gear cutting using milling machine.
4. To perform flat surface operation on a block using shaper.
5. To perform Drilling & Tapping operations.
6. To perform precise surface grinding operations.
7. To perform precision cylindrical grinding operations.
8. To perform splines on a block using slotting machine.
9. To perform step turning operation using CNC lathe.

Part B- List of Experiments

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. To Study the Angle and taper measurements by Bevel protractor, Sine bars, etc.
4. Measurements by Gear Tooth Vernier Calipers.
5. To study about the Tool makers microscope and its application
6. Surface Roughness Measurement

THERMAL ENGINEERING LAB

Course Title: THERMAL ENGINEERING LAB	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):0:0:3	**Credits:1.5**
Type of Course: PRACTICAL	**Course Code: R4MEPC17**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Basic understanding of Thermodynamics, Heat Transfer, and Fluid Mechanics.	

Course Objectives:

1.To provide hands on experience in operating various types of internal combustion engines and understands their functioning and performance.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT LEVEL**
Identify the valves and ports opening and closing of IC engines and Assembly and Dis-assembly of IC Engines. (BL-3)	3	2	2	3	1	3	L3
Find the performance characteristics of an internal combustion engines (BL-1)	3	2	1	2	1	2	L1
Solve the heat load by drawing the Heat Balance sheet (BL-3)	3	3	2	2	2	3	L3
Demonstrate the performance of engine by economical speed tests and Study of Boilers (BL-2)	3	2	2	3	2	3	L2
Analyze the performance parameters like IP, BP and FP for multi cylinder engines (BL-2)	3	3	2	2	2	3	L2

SYLLABUS

List of Experiments

1. I.C. Engines valve / port timing diagrams.
2. Testing of Fuels – Viscosity, flash point/fire point, carbon residue, calorific value.
3. I.C. Engines performance test and Exhaust emission measurements (4 -stroke diesel engine)
4. I.C. Engines performance test and Exhaust emission measurements (2-stroke petrol engine)
5. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Determination of FP by retardation and motoring test on IC engine.
7. I.C. Engines heat balance at different loads and show the heat distribution curve.
8. Economical speed test of an IC engine.
9. Performance test on variable compression ratio engines.
10. Performance test on reciprocating air compressor unit.
11. Dis-assembly / assembly of different parts of two wheelers. 3 wheelers & 4 wheelers. Tractor &Heavy-duty engines covering 2-stroke and 4 stroke, SI and CI engines.
12. Study of boilers, mountings and accessories.

DRONE TECHNOLOGY & INSTRUMENTATION CONTROL SYSTEMS LAB

Course Title: Drone Technology & Instrumentation Control Systems lab	**YEAR -III SEM-I**
Teaching Scheme(L:T:P):0:0:2	**Credits:1**
Type of Course: PRACTICAL	**Course Code: R24MESC03**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Basic knowledge of Basic Electronics and Electrical Engineering	

Course Objectives:

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics Competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamitic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real life engineering problems
5. To study and calibrate displacement, temperature, speed, capacitance and pressure measuring instruments

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT LEVEL**
Assemble, integrate, and operate drone/robotic systems by interfacing mechanical components, motors, sensors, controllers, and electronic circuits while following standard safety procedures.	3	2	3	3	1	3	L3
Analyze drone flight performance by conducting manual flight operations, evaluating hover stability, monitoring battery performance, and selecting suitable power systems for specific applications.	3	3	2	2	1	3	L4
Perform calibration and testing of various measuring instruments and transducers used for pressure, temperature, displacement, and strain measurement applications.	3	2	2	3	1	3	L3
Analyze the characteristics, accuracy, sensitivity, and performance of instrumentation systems including LVDT, thermocouple, RTD, strain gauge, and pressure measurement devices.	3	3	2	2	1	3	L4

SYLLABUS

List of Experiments

Drone-Based Experiments:

1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Safety precautions and pre-flight checklist demonstration.
5. Manual flying of a drone in a confined indoor/ outdoor space.
6. Measuring hover stability and battery performance.

Instrumentation Control Systems Experiments:

1. Calibration of pressure gauge.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge.
5. Calibration of thermocouple. .
6. Calibration of resistance temperature detector.

Virtual Lab:

1. Simulation of drone flight path using DroneSim Pro or similar tools

   https://www.dronesimpro.com

2. Virtual slicing and G-code simulation using Cura

   https://ultimaker.com/software/ultimaker-cura

3. Simulation of drone flight path using open-source software

EMPLOYABILITY SKILLS- I: COMPETITIVE CODING

Course Title: Employability Skills I: Competitive Coding	**YEAR -III SEM-I**
Teaching Scheme (L:T:P): 0:0:2	**Credits:1**
Type of Course: Tutorial + Practical	**Course Code: R24HS08**
Continuous Internal Evaluation: 30 Marks	**Semester End Exam: 70 Marks**
Pre requisites: Basics of C programming , Data structures , SQL	

COURSE OBJECTIVES:

1. Develop a clear understanding of C programming fundamentals and key coding concepts.
2. Gain hands-on experience with data structures, algorithms, and problem-solving techniques.
3. Achieve proficiency in SQL query writing for database interaction.
4. Prepare for online coding assessments, technical interviews, and placement processes at different MNCs.

COURSE OUTCOMES:

CO1: Demonstrate proficiency in C programming, including core concepts like functions, arrays, pointers, and control flow.

CO2: Apply data structures and algorithms effectively to solve complex programming problems.

CO3: Write and optimize SQL queries for database operations and management.

CO4: Gain confidence to perform well in online coding assessments and technical interviews, with practical preparation for placement processes at different MNCs.

Course Outcomes(COS)	**Mapping with POs and PSOs**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PS01**	**BT LEVEL**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	L2
CO2	3	2		2	3	-	-	-	-	-	-	-	L3
CO3	2	-	-	-	3	-	-	-	-	-	-	-	L3
CO4	-	-	-	-	-	-	-	-	-	3	2	3	L5

Part-A Module 1: Programming Basics in C (10 Hours)

Topics Covered:

- Loops: for, while, do-while Basics of C: Data types, variables, input/output, operators Control Flow: if-else, switch statements, nested conditions
- Functions: Declaration, recursion, parameter passing
- Arrays & Strings: 1D and 2D arrays, string operations
- Pointers: Basics, arrays with pointers, dynamic memory allocation
- Practice Programs: Factorial, palindrome, Fibonacci, Armstrong, prime, pattern printing

Module 2: Data Structures & Algorithms (30 Hours) Subtopics:

- Arrays & Strings: Searching (Linear, Binary), Sorting (Bubble, Selection, Insertion), Anagram check, Substring search
- Linked Lists: Singly linked list operations, reversal, Floyd's cycle detection
- Stacks & Queues: Stack and Queue (array & linked list), Infix to Postfix, Evaluation
- Trees: Binary Tree, Binary Search Tree, Traversals, Mirror, Height, Leaf nodes
- Recursion & Backtracking: N-Queens, Subsets, Permutations
- Advanced Sorting: Merge Sort, Quick Sort, Binary Search Applications
- Hashing & Sets: Duplicate detection, frequency count
- Time & Space Complexity: Big O notation, complexity analysis

Practice Platforms: Hacker Rank, Leet Code, Code Studio

Module 3: SQL for Online Assessment & Interviews (10 Hours) Topics

Covered:

- SQL Basics: Syntax, constraints, primary & foreign keys
- Data Operations: SELECT, INSERT, UPDATE, DELETE, WHERE
- Clauses: GROUP BY, HAVING, ORDER BY, LIMIT
- Aggregate Functions: COUNT, SUM, AVG, MIN, MAX
- Joins: INNER, LEFT, RIGHT, FULL OUTER JOIN
- Sub queries: Single row, multiple row, nested queries
- Hands-on Practice: Queries on student, employee, and product datasets
- Tools: SQLite, MySQL, Oracle Live SQL

Part-B

List of Competitive Coding Experiments (Service-Based Companies Focus) (20 Hours)

Basic Programming & Logic Building

1. Factorial, Fibonacci, Palindrome, Armstrong, Prime Number Checker
2. Pattern Printing Programs (Pyramids, triangles, numbers, characters)
3. Swapping Numbers Without Temp Variable
4. GCD & LCM Calculation

Array-Based Problems

5. Find Largest, Smallest, Second Largest Element
6. Array Rotation (Left/Right)
7. Sub array with Given Sum
8. Duplicate Removal / Frequency Count
9. Prefix Sum / Running Sum Array

String Manipulation

10. Palindrome Checker (String-Based)
11. Anagram Checker
12. Reverse Words in a String
13. Count Vowels, Consonants, Digits, Spaces
14. Character Frequency Map using Hashing

Searching & Sorting

15. Binary Search Implementation
16. Bubble, Insertion, Selection Sort
17. Sort 0s, 1s, and 2s (Dutch National Flag Problem)
18. Merge Sort or Quick Sort (Optional)

Linked List (Basic Implementation)

19. Insert, Delete, Reverse Linked List
20. Detect Loop using Floyd's Cycle Algorithm

Matrix Problems

21. Spiral Traversal of a Matrix
22. Transpose of a Matrix
23. Search in a Row-wise Sorted Matrix

Recursion & Backtracking

24. Tower of Hanoi
25. N-Queens Problem
26. Subset Sum Problem

Stacks and Queues

27. Infix to Postfix Conversion
28. Postfix Evaluation
29. Queue Implementation using Arrays/Stacks

Hashing & Sets

30. Find First Non-Repeating Character
31. Count Pairs with Given Sum
32. Intersection/Union of Two Arrays

SQL Integration (Optional for Project)

33. Create a mini project that fetches or stores data using SQL (C + SQL Integration)

Text Books:

1. C Programming Language, Brian W. Kernighan, Dennis M. Ritchie, Edition: 2nd Edition Publisher: Prentice Hall, Year: 1988.
2. Data Structures and Algorithms Made Easy, Narasimha Karumanchi, Edition: 1st Edition

   Publisher: CareerMonk Publications, Year: 2011.
3. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
   Edition: 3rd Edition,Publisher: MIT Press,Year: 2009.
4. SQL For Smarties: Advanced SQL Programming,Joe Celko, Edition: 4th Edition Publisher: Morgan Kaufmann,Year: 2010.
5. Competitive Programming, Steven Halim, Felix Halim,Edition: 3rd Edition,Publisher: Springer,Year: 2013
6. Data Structures Using C,Reema Thareja, Edition: 2nd Edition, Publisher: Oxford University Press, Year: 2011.
7. Cracking the Coding Interview, Gayle Laakmann McDowell, Edition: 6th Edition Publisher: CareerCup, Year: 2015.

E- resources:

1. Geeks for Geeks Website: https://www.geeksforgeeks.org
2. Hacker Rank : Website: https://www.hackerrank.com
3. Code forces : Website: https://codeforces.com
4. Leet Code : Website: https://leetcode.com
5. Code Chef : Website: https://www.codechef.com
6. Interview Bit Website: https://www.interviewbit.com
7. Top Coder : Website: https://www.topcoder.com
8. Hacker Earth : Website: https://www.interviewing.io

INDUSTRIAL EVALUATION/ COMMUNITY SERVICE INTERNSHIP

Course Title: Industrial Evaluation/ Community Service Internship	**YEAR -III SEM-I**
Teaching Scheme (L:T:P): 2:0:0	**Credits:2**
Type of Course: INTERNSHIP	**Course Code:R24IN01**

Course Objectives:

The primary goal is to transform passive theoretical learners into proactive, socially responsible field engineers.

COURSE OUTCOMES	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Analyze industrial environments, corporate hierarchies, safety regulations, and end-to-end plant operations.	2	3	1	2	1	2	L4
Appraise production capabilities, machinery setups, and product optimization practices observed on-site.	3	3	2	2	1	3	L5
Formulate technical or socio-economic project documentations and deliver convincing structural presentations.	2	2	2	1	1	2	L6
Identify concrete societal issues by conducting targeted surveys and communicating with local community figures.	1	3	2	2	1	1	L4
Design eco-friendly, highly affordable, and sustainable engineering alternatives for community constraints	3	3	3	2	2	3	L6
Demonstrate active teamwork, professional accountability, and empathetic leadership values in interdisciplinary settings.	1	1	1	1	2	1	L3

Part A: Industrial Evaluation Objectives

- **Industry Immersion**: To expose students to large-scale production, shop floors, and manufacturing plant architectures**.**
- Workflow Observation: To help students comprehend operational management, standard operating procedures (SOPs), supply chains, and industrial workflows.

- **Quality & Regulation Standards:** To ground students in safety metrics, industry certifications (e.g., ISO, Lean, Six Sigma), and environmental protocols.
- **Professional Documentation**: To train students in drafting clear industrial project reports, logbooks, and executive summaries

Part B: Community Services Objectives

- **Societal Consciousness:** To create awareness regarding rural or urban community limitations in areas like sanitation, drinking water, infrastructure, and clean energy.
- **Grassroots Problem Identification:** To teach students how to trace, map, and prioritize specific local bottlenecks that engineering logic can resolve.
- **Affordable Innovation:** To push students toward designing low-cost, eco-friendly, and highly sustainable infrastructure frameworks.
- **Empathy & Civic Engagement:** To foster a strong sense of civic responsibility, national development, and professional ethics.

Evaluation Criteria

Performance in this course is evaluated through direct field-based assignments rather than standard written examinations:

1. **Logbook and Attendance Verification:** Signed daily notes from industry mentors or village/NSS community headers.
2. **Technical Field Report:** A detailed analytical report outlining the industrial process observed or the community project undertaken.
3. **Internal Viva-Voce & Presentation:** Defense of the field experiences before a departmental evaluation panel

TECHNICAL PAPER WRITING AND INTELLECTUAL PROPERTY RIGHTS

Course Title: TPR & IPR	**YEAR -III SEM-I**
Teaching Scheme (L:T:P): 2:0:0	**Credits:0**
Type of Course: LECTURE	**Course Code:R24MC06**

Course Objectives:

1. Introduce students to research fundamentals, including topic selection, literature review, and the structured components of a technical paper.
2. Familiarize students with research design, data collection methods, and statistical analysis, alongside proper citation and referencing styles.
3. Develop students' skills in writing clear and concise technical papers and delivering professional presentations of research findings.
4. Provide a comprehensive overview of intellectual property rights, covering patents, copyrights, trademarks, and trade secrets.
5. Raise awareness of ethical considerations in research, emerging issues in IPR (such as digital rights and open access), and the importance of protecting intellectual property in collaborative settings.

COURSE OUTCOMES	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Identify research problems, conduct literature reviews, and understand the structure and components of technical papers.	2	3	-	2	2	-	L2 Understand
Apply appropriate research design, data collection methods, statistical analysis techniques, and citation/referencing styles in research work	2	3	-	3	2	1	L3 Apply
Develop clear, concise, and well-structured technical papers and effectively present research findings using professional presentation skills.	-	1	-	1	2	-	L3 Apply
Explain the fundamentals of Intellectual Property Rights (IPR), including patents, copyrights, trademarks, and trade secrets.	1	1	-	-	2	-	L2 Understand
Analyze ethical issues in research and evaluate emerging trends in IPR, such as digital rights, open access, and intellectual property protection in collaborative environments.	-	2	-	1	3	-	L4 Analyze

SYLLABUS

UNIT–I

Introduction to Research and Technical Writing: Fundamentals of Research: Definition, objectives, types (basic and applied), and research methodology. Types of Technical Documents: Research papers, theses, and technical reports. Literature Review: Importance, methods for conducting surveys, and reviewing scholarly articles. Research Topic Selection: Identifying research gaps and formulating research questions

UNIT–II

Research Design and Data Collection: Research Design: Types (exploratory and descriptive) and planning research. Data Collection: Primary vs. secondary data, qualitative and quantitative methods. Visual Data Representation: Graphs, tables, and charts. Citation Styles: Overview of APA and IEEE formats

UNIT –III

Writing and Presenting Technical Papers: Writing Skills: Clarity, conciseness, and coherence in technical writing. Abstract and Conclusion: Techniques for writing effectively. Presentation Skills: Preparing presentations and using visual aids.

UNIT–IV

Intellectual Property Rights (IPR): Fundamentals of IPR: Introduction to patents, copyrights, and trademarks. Patents: Basic criteria for patentability. Case Studies: Real-world applications of IPR in engineering.

UNIT–V

Ethical Considerations in Research: Ethical Issues: Plagiarism avoidance, responsible authorship, and ethical use of data.
Open Access: Introduction to Creative Commons and open-source research.

TEXTBOOK:

1. Kumar, R. (2018). Research methodology: A step-by-step guide for beginners (5th ed.). SAGE Publications.
2. Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approach (5th ed.). SAGE Publications.

REFERENCES:

1. Alred, G. J., Brusaw, C. T., &Oliu, W. E. (2020). The Handbook of Technical Writing (12th ed.). Bedford/St. Martin's.
2. Day, R. A., &Gastel, B. (2016). How to write and publish a scientific paper (8th ed.). Cambridge University Press.
3. Menell, P. S., Lemley, M. A., Merges, R. P., &Balganesh, S. (2020). Intellectual Property in the New Technological Age 2020: Vol. II Copyrights, Trademarks, and State IP Protections.
4. Singh, A. K. (2018). Intellectual property rights: Unleashing the knowledge economy. Springer.

UNCONVENTIONAL MACHINING PROCESSES

Course Title: UNCONVENTIONAL MACHINING PROCESSES	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE1.1**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Fundamentals of manufacturing technology, material science, and machining processes. Basic knowledge of mechanical engineering concepts such as heat transfer, stress-strain behavior, and material removal mechanisms is required for understanding modern machining techniques like EDM, ECM, USM, and laser machining.	

Course Objectives:

1. To Analyze basic concepts of modern machining processes and ultrasonic machining.
2. To interpret the principles and procedure of principles of electro chemical machining.
3. To apply the principles and procedure of thermal metal removal processes.
4. To illustrate the principles and procedure of electron beam machining, laser beam machining and plasma machining.
5. To interpret the principles and procedure of abrasive jet machining.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Analyze basic concepts of modern machining processes and ultrasonic machining.	3	2	2	2	-	3	L4
Interpret the principles and procedure of principles of electro chemical machining.	3	2	3	2	-	3	L2, L3
Apply the principles and procedure of thermal metal removal processes.	3	2	3	3	-	3	L3
Illustrate the principles and procedure of electron beam machining, laser beam machining and plasma machining.	3	2	3	2	-	3	L2, L3
Interpret the principles and procedure of abrasive jet machining.	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I

INTRODUCTION: Need for non-traditional machining methods-classification of modern machining processes considerations in process selection, applications.

Ultrasonic machining – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations.

UNIT–II

ELECTRO – CHEMICAL MACHINING: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate, fundamentals of chemical, machining, advantages and applications.

UNIT–III

Thermal Metal Removal Processes: General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface.

UNIT–IV

Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications

Plasma Machining: Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT-V

Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipment, process variables, mechanics of material removal, MRR, application and limitations, magnetic abrasive finishing, abrasive flow finishing, Electro stream drilling, shaped tube electrolytic machining.

TEXT BOOKS:

1. Fundamentals of Machining Processes-Conventional and non – conventional processes/Hassan Abdel – Gawad El-Hafy/CRCPress-2016.

REFERENCES:

1. Modern Machining Process / Pandey P.C. and Shah H.S./TMH.
2. New Technology / Bhattacharya A/ the Institution of Engineers, India1984.
3. Non-Traditional Manufacturing Processes / Benedict

ADDITIVE MANUFACTURING

Course Title: ADDITIVE MANUFACTURING	**YEAR -III SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE1.2**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Basic understanding of manufacturing processes, engineering materials, computer-aided design (CAD), and production engineering concepts. Knowledge of prototyping methods, material behavior, and layer-based manufacturing techniques is helpful for studying additive manufacturing systems and rapid prototyping technologies.	

Course Objectives:

1. To analyze the principles of prototyping, classification of RP processes and liquid-based RP systems
2. To illustrate and apply different types of solid-based RP systems.
3. To interpret and apply powder-based RP systems.
4. To discuss and apply various rapid tooling techniques.
5. To analyze different types of data formats and to explore the applications of AM processes in various fields.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Analyze the principles of prototyping, classification of RP processes and liquid-based RP systems	3	2	2	2	-	3	L4
Illustrate and apply different types of solid-based RP systems.	3	2	3	2	-	3	L2, L3
Interpret and apply powder-based RP systems.	3	2	3	2	-	3	L2, L3
Discuss and apply various rapid tooling techniques.	3	2	3	3	-	3	L2, L3
Analyze different types of data formats and to explore the applications of AM processes in various fields.	3	2	3	3	2	3	L4, L5

SYLLABUS

UNIT –I

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT–II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT–III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. three-dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT–IV

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting process. Direct rapid tooling: Direct AIM, LOM Tools, and Direct Metal Tooling using 3DP.

UNIT-V

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, and Newly Proposed Formats.

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, RP medical and bioengineering applications: customized implants and prosthesis, forensic sciences.

TEXT BOOKS:

2. Rapid prototyping: Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific publications

REFERENCES:

1. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
2. Wohlers Report 2000 /Terry T Wohlers/Wohlers Associates
3. Rapid Prototyping & Manufacturing / Paul F.Jacobs/ASME Press
4. Rapid Prototyping / Chua and Liou

TRIBOLOGY

Course Title: TRIBOLOGY	**YEAR -III SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE1.3**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**

Pre requisites: Fundamentals of engineering materials, mechanics, and lubrication principles. Basic knowledge of friction, wear mechanisms, surface engineering, and material properties is essential for understanding tribological behavior in mechanical systems and industrial applications..

Course Objectives:

1. Provide a comprehensive understanding of tribology, including friction, wear, and lubrication principles in engineering systems.
2. Apply Theories of Friction to Evaluate the Friction Behavior of Engineering Materials For Applications In Modern Engineering Systems
3. Solve Wear-Related Challenges by Evaluating Wear Characteristics of Different Materials
4. Impart Knowledge of Different Types of Lubricants and The Criteria for Their Selection In Engineering Applications
5. Explore The Recent Advances in Tribology, And Emerging Technologies for Sustainable Lubrication Practices

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Explain the fundamental concepts of tribology, engineering surface characteristics, and surface measurement methods.	3	2	2	2	-	3	L2
Apply friction theories and mechanisms to analyze frictional behavior in metallic and nonmetallic materials using appropriate measurement techniques.	3	3	3	3	-	3	L3, L4
Analyze the mechanisms and types of friction and wear in metallic and non-metallic materials under different operating conditions	3	3	2	3	-	3	L4
Select appropriate lubricants in engineering applications.	3	2	3	2	-	3	L3
Solve lubrication and tribology related issues in industrial systems through lubricant testing methods, sustainable practices	3	3	3	3	2	3	L3, L4, L5

SYLLABUS

UNIT –I Introduction to Tribology

Definition and scope of tribology, importance in mechanical systems. Basic concepts of friction, wear, and lubrication. Engineering surfaces: surface topography and surface roughness, typical surface layers and their properties. Surface measurement methods include surface profilometry, optical microscopy, and scanning electron microscopy. Surface contact behavior: real versus apparent contact area.

UNIT–II Theories of Friction

Mechanisms of friction: adhesion and deformation, stick-slip motion, and rolling friction. Friction behavior of engineering materials, including metals and non-metallic materials such as polymers and ceramics. Friction measurement techniques using various tribometers. Theoretical models and modern theories of friction.

UNIT–III Wear Mechanisms

Types of wear and their mechanisms: adhesive wear, abrasive wear, erosive wear, corrosive/oxidative wear, and fatigue wear. Wear characteristics of different materials, such as metals, ceramics, and polymers. Wear testing methods including pin-on-disc tribometer and reciprocating tribometer. Wear reduction techniques and the role of surface engineering.

UNIT–IV Lubricants and Lubrication

Lubricants and the purpose of lubrication in mechanical systems. Types of lubricants: liquid, semi solid, and solid lubricants. General properties of liquid lubricants. Detailed study of mineral oils, synthetic oils, animal and vegetable oils, blended oils, and their characteristics. Lubricant additives and their effects. Semi-solid lubricants or greases and solid lubricants. Criteria for selection of lubricants in engineering applications.

UNIT-V Lubricant Testing and Industrial Applications

Testing of lubricants using viscometer and four ball tester. Application of lubricants and tribology in industrial systems such as bearings, gears, cutting tools, and engines. Sustainable lubrication practices and introduction to green lubricants. Recent advances in tribology, including nanotribology, bio-lubricants, and smart lubrication systems.

TEXT BOOKS:

1. Engineering Tribology/ Gwidon W. Stachowiak & Andrew W. Batchelor/ Elesevier
2. Engineering Tribology/ Prasanta Sahoo / PHI

REFERENCES:

1. Tribology – B.C. Majumdar
2. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI
3. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.

HYDROGEN FUEL CELL TECHNOLOGY

Course Title: HYDROGEN FUEL CELL TECHNOLOGY	**YEAR -III SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE1.4**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Fundamentals of thermodynamics, chemistry, electrochemistry, heat transfer, and energy conversion systems. Basic understanding of renewable energy technologies and fluid mechanics is useful for studying hydrogen production, storage systems, and fuel cell applications.	

Course Objectives:

1. Know the working principle of different metal casting processes and gating system To interpret the variation of SF&BM indeterminate beam.
2. Classify the welding processes, working of different types of welding processes and welding defects
3. Know the nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes
4. Understand the principles of forging, tools and dies, working of forging processes
5. Know about the Additive manufacturing

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Understand the Fuel Cells as a promising technology in the context of clean power sustainability and alternative fuels for shipping.	3	2	2	2	2	3	L2
Understand and analyze current advancements in fuel cell technologies, including different types, materials, and applications	3	3	2	3	2	3	L2, L4
Apply the fundamental concepts and operational principle	3	2	3	2	-	3	L3
Analyze relative advantages / disadvantages and hydrogen generation/storage technologies.	3	3	2	3	2	3	L4
Compare and select appropriate hydrogen cell technologies for the various applications.	3	3	3	3	2	3	L4, L5

SYLLABUS

UNIT –I

Hydrogen – Fundamentals

Hydrogen – Fundamentals: Hydrogen as a source of energy, physical and chemical properties, salient characteristics, relevant issues and concerns

UNIT–II

Hydrogen Storage and Applications

Hydrogen Storage and Applications: Production of hydrogen, steam reforming, water electrolysis, gasification and woody biomass conversion, biological hydrogen production, photo dissociation, direct thermal or catalytic splitting of water, hydrogen storage options, compressed gas, liquid hydrogen, hydride, chemical storage, safety and management of hydrogen, applications of hydrogen, applications of hydrogen

UNIT–III

Fuel Cells- Types

Fuel Cells- Types: Brief history, principle, working, thermodynamics and kinetics of fuel cell process, types of fuel cells; AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits, performance evaluation of fuel cell, comparison of battery Vs fuel cell

UNIT–IV

Fuel Cells -Application and Economics

Fuel Cells -Application and Economics: Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells

UNIT-V

Fuel Cell Mass Transport

Fuel Cell Mass Transport: Transport in electrode versus flow structure, transport in electrode: diffusive transport, transport in flow Structures: convective transport.

TEXT BOOKS:

1. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma

REFERENCES:

1. Bent Sorensen (Sorensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier Academic Press, UK
2. Kordesch, K and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany
3. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork Ltd., London
4. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ch66/preview

INDUSTRIAL HYDRAULICS AND PNEUMATICS

Course Title: INDUSTRIAL HYDRAULICS AND PNEUMATICS	**YEAR -III SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE1.5**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Fundamentals of fluid mechanics, thermodynamics, and mechanical engineering systems. Basic knowledge of hydraulic and pneumatic components, fluid power transmission, pressure-flow relationships, and control systems is required for understanding industrial hydraulic and pneumatic applications.	

Course Objectives:

1. To explain the basic concepts of fluid power
2. To illustrate the functions of elements of Hydraulic and Pneumatic systems
3. To analyze the functions of hydraulic and Pneumatic circuits
4. To illustrate the working of various hydraulic and pneumatic devices.
5. To interpret the procedure of installation, maintenance and troubleshooting of hydraulic and Pneumatic systems

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Explain the basic concepts of fluid power	3	2	2	1	-	3	L2
Illustrate the functions of elements of Hydraulic and Pneumatic systems	3	2	3	2	-	3	L2, L3
Analyze the functions of hydraulic and Pneumatic circuits	3	3	3	3	-	3	L4
Illustrate the working of various hydraulic and pneumatic devices.	3	2	3	2	-	3	L2, L3
Interpret the procedure of installation, maintenance and troubleshooting of hydraulic and Pneumatic systems	3	3	3	3	2	3	L2, L3, L4

SYLLABUS

UNIT –I

Fluid Power

Power transmission modes, hydraulic systems, pneumatic systems, laws governing fluid flow: Pascal9s law, continuity equation, Bernoulli9s theorem, Boyle9s, Charles9, Gay lussec9 laws, flow through pipes - types, pressure drop in pipes, working fluids used in hydraulic and pneumatic systems- types, ISO/BIS standards and designations, properties.

UNIT–II

Hydraulic and Pneumatic Elements:

Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria, pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison, hydraulic Actuators, Control valves, Accessories - their types, construction and working, pneumatic Pipes - materials, designations, standards, properties and piping layout, air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements, pneumatic Actuators and Control valves - types, construction, working, materials and specifications

UNIT–III

Hydraulic and Pneumatic Circuits

ISO symbols used in hydraulic and pneumatic circuit, basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications, basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications, pneumatic Logic circuit design - classic method, cascade method, step counter method, Karnaugh Veitch maps and combinational circuit design.

UNIT–IV

Hydraulic and Pneumatic Devices

Hydraulic and Pneumatic devices – Concept and applications, construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic jack, Hydraulic press, Automotive power steering, Automotive pneumatic brake, Automotive air suspension, Pneumatic drill, Pneumatic gun.

UNIT-V

Installation, Maintenance and Trouble-Shooting

Installation of hydraulic and pneumatic system causes and remedies for common troubles arising in hydraulic elements, maintenance of hydraulic systems, causes and remedies for troubles arising in pneumatic elements, maintenance of pneumatic systems.

TEXT BOOKS:

1. Majumdar, S.R. Oil Hydraulic Systems Tata Mcgraw-Hill Publication, New Delhi,3/e, 2013.
2. Majumdar, S.R. Pneumatic Systems Tata Mcgraw-Hill Publication, New Delhi,3/e, 2013

REFERENCES:

1. Srinivasan, R. Hydraulic and Pneumatic Controls Vijay Nicole Imprints Private, New Delhi, Limited, 2/e, 2008.
2. Jagadeesha, T. Fluid Power Generation, Transmission and Control Universities Press (India) Private Limited, New Delhi,1/e, 2014.
3. Jagadeesha, T. Pneumatics Concepts, Design And Applications Universities Press (India) Private Limited, New Delhi,1/e, 2014.
4. Parr, Andrew Hydraulic And Pneumatics A Technician9s and Engineer9s Guide Jaico Publishing House, New Delhi,2/e, 2013.
5. Shanmuga Sundaram, K . Hydraulic And Pneumatics Controls - Understanding Made Easy S. Chand Company Ltd., New Delhi, 1/e, 2006

THEORY OF MACHINES

Course Title: THEORY OF MACHINES	**YEAR -III SEM-II**
Teaching Scheme (L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEPC18**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: Basic knowledge of Engineering Mechanics, Engineering Mathematics, and fundamentals of Mechanical Engineering.	

Course Objectives:

1. To interpret the nature and role of the kinematics of machinery, mechanisms and machines
2. The course includes velocity and acceleration diagrams, analysis of mechanisms joints, it exposes the students to various kinds of power transmission devices like belt, rope, chain and gear drives and their working principles and their merits and demerits.
3. To analyze dynamic forces of slider, crank mechanism and design of flywheel
4. To analyze the methods of balancing reciprocating and rotary masses.
5. To illustrate the concept of vibrations and its significance on engineering design.

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT**
Interpret a mechanism for a given plane motion. analyze motion of different planar mechanisms with lower and higher pairs	3	3	-	2	-	3	L4
Select a power transmission system for a given application and analyze different transmission systems.	-	3	3	-	2	3	L5
Analyze dynamic forces of slider crank mechanism and design of flywheel	3	3	3	-	-	3	L5
Analyze the methods of balancing reciprocating and rotary masses.	3	3	-	-	-	3	L4
Illustrate the concept of vibrations and its significance on engineering design	3	2	3	-	-	3	L3

SYLLABUS

UNIT–I

MECHANISMS: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained.

Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle chain – single and double slider crank chains.

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russul – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight-line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling–application–problems.

UNIT–II

KINEMATICS: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Klein's construction, determination of Coriolis component of acceleration.

POWER TRANSMISSION (BELT, CHAIN AND GEAR):
Belt Drive: Type of belts, flat belt, V-belt & its applications, material for flat and V-belt, Selection of belts, Angle of lap, length of belt (No derivation), Slip and creep, Determination of velocity ratio of tight side and slack side tension, Power transmitted by belt. (numerical on power transmission by belt)

Chain Drives: Types of chains and sprockets, Advantages & Disadvantages of chain drive over other drives (No numerical on Chain drive). Gear Drives: Classification of gears, Law of gearing, Concept of Conjugate profile (Involute only) Spur gear terminology. Types of gear trains, Train value & velocity ratio for simple, compound, reverted and epicyclic gear trains. (No numerical on Gear drive). Comparison between Belt drive, Chain drive and Gear drive

UNIT –III

CAMS Definitions of cam and followers – their uses – Types of followers and cams – Terminology Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

TURNING MOMENT DIAGRAMS: Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.

UNIT–IV

GOVERNERS: Watt, Porter and Proell governors, spring loaded governors – Hartnell and Hartung with auxiliary springs. sensitiveness, isochronism and hunting

BALANCING: Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses.

UNIT–V

VIBRATIONS: Free Vibration of spring mass system –Natural frequency-types of damping – damped free vibration, Simple problems on forced damped vibration, vibration isolation and transmissibility transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly's methods, Raleigh's method, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems.

TEXTBOOK:

1. "Theory of Machines", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd Ed-2009
2. "Theory of Machines", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Ed 2006/
3.

REFERENCES:

1. "Theory of Machines & Mechanisms", J.J. Uicker, , G.R. Pennock, J.E. Shigley, OXFORD 3rd Ed. 2009.
2. "Theory of Machines" by Thomas Bevan, CBS Publication 1984.
3. "Design of Machinery" by Robert L. Norton, McGraw Hill, 2001.
4. "Mechanisms and Dynamics" of Machinery by J. Srinivas, Scitech Publications, Chennai,2002.
5. "Dynamics of machinery" by J. B. K. Das & P. L. S. Murthy.

HEAT TRANSFER

Course Title: HEAT TRANSFER	**YEAR -III SEM-II**
Teaching Scheme (L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEPC19**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: To effectively understand this course, students should have prior knowledge in the Engineering Mathematics, Thermodynamics, Fluid Mechanics, and basic Engineering Physics.	

Course Objectives:

1. To interpret the different modes of heat transfer and conduction heat transfer through various solid bodies
2. To analyze the one-dimensional steady state heat conduction heat transfer and one-dimensional transient heat conduction
3. To illustrate the basic concepts of convective heat transfer and forced convection heat transfer of external flows and internal flows
4. To analyze the free convection heat transfer concepts and heat transfer processes in heat exchangers
5. To interpret the concepts of film wise condensation, drop wise condensation and radiation heat transfer

COURSE OUTCOMES	PO1	PO2	PO3	PO4	P011	PS01	BT
Interpret the different modes of heat transfer and conduction heat transfer through various solid bodies	3	2	-	-	-	3	L2
Analyze the one-dimensional steady state heat conduction heat transfer and one-dimensional transient heat conduction	3	3	-	2	-	3	L4
Illustrate the basic concepts of convective heat transfer and forced convection heat transfer of external flows and internal flows	3	2	-	-	-	3	L2
Analyze the free convection heat transfer concepts and heat transfer processes in heat exchangers	3	3	2	2	-	3	L4
Interpret the concepts of film wise condensation, drop wise condensation and radiation heat transfer	3	2	-	-	-	3	L2

SYLLABUS

UNIT–I

Introduction
Modes and mechanisms of heat transfer–Basic laws of heat transfer –General discussion about applications of heat transfer.
Conduction Heat Transfer
Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions
One Dimensional Steady State Conduction Heat Transfer
Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation. Variable Thermal conductivity – systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature.

UNIT–II

One Dimensional Transient Conduction Heat Transfer
Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.
Convective Heat Transfer
Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham π Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

UNIT –III

Forced convection:
External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.
Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this Use of empirical relations for Horizontal Pipe Flow and annulus flow.
Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

UNIT–IV

Heat Transfer with Phase Change:
Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling

Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT–V

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

TEXTBOOK:

1. Heat Transfer by HOLMAN, Tata McgrawHill
2. Heat Transfer by P.K.Nag, TMH

REFERENCES:

1. Fundamentals of Heat Transfer by Incropera& Dewitt, John wiley
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C.Sachdeva, NewAge.
3. Heat& Mass Transfer by Amit Pal – Pearson Publishers
4. Heat Transfer by Ghosh dastidar, Oxford University press.
5. Heat Transfer by a Practical Approach, YunusCengel, Boles, TMH
6. Engineering Heat and Mass Transfer by Sarit K. Das, DhanpatRai Pub

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyan is used to design and analyze various thermal processes and thermal equipment.

THEORY OF MACHINES LAB

Course Title: THEORY OF MACHINES LAB	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):0:0:3	**Credits:1.5**
Type of Course: PRACTICAL	**Course Code: R24MEPC20**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Basic knowledge of Theory of Machines, Engineering Mechanics, and Engineering Mathematics.	

Course Objectives:

1. The students will acquire the knowledge

   To analyze gyroscope, frequency of free and forced vibration and study static and dynamic balancing.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT**
Examine the motion of a motorized gyroscope when the couple is applied along its spin axis.	3	3	-	3	-	3	L4
Find the frequency of undamped and damped free vibration of an equivalent spring mass system.	3	2	-	3	-	3	L1
Find the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation	3	2	-	3	-	3	L1
Interpret the static and dynamic balancing using rigid blocks	3	3	-	3	-	3	L2
Interpret the moment of inertia of a flywheel and determine whirling speed of shaft theoretically and experimentally	3	3	2	3	-	3	L2

SYLLABUS

List of Experiments

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system.
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel.

8. To plot follower displacement vs cam rotation for various Cam Follower systems.

9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism.

10. To find coefficient of friction between belt and pulley.

11. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency.

12. To study various types of gears- Spur, Helical, Worm and Bevel Gears.

HEAT TRANSFER LAB

Course Title: HEAT TRANSFER LAB	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):0:0:3	**Credits:1.5**
Type of Course: PRACTICAL	**Course Code: R24MEPC21**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Basic knowledge of Heat Transfer, Thermodynamics, and Fluid Mechanics.	

Course Objectives:

1.The laboratory course is aimed to provide the practical exposure to the students with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for several geometries.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT**
Find the thermal conductivity of different materials, composite slabs and powders.	3	2	-	3	-	3	L3
Solve heat transfer coefficient for free and forced convection and pin fin efficiency for forced and free convection	3	3	-	3	-	3	L4
Examine the Stefan Boltzmann Constant and emissivity of grey body	3	2	-	3	-	3	L4
Compare parallel and counter flow heat exchanger performance characteristics and investigation of Lambert's cosine law	3	3	2	3	-	3	L5
Solve the heat transfer rate through lagged pipes and heat transfer rate in film and drop wise condensation	3	3	-	3	-	3	L4

SYLLABUS

List of Experiments

1. Determination of overall heat transfer co-efficient of a composite slab.
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere.
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin .
6. Determination of heat transfer coefficient in natural and forced convection
7. Determination of effectiveness of parallel and counter flow heat exchangers.
8. Determination of emissivity of a given surface.
9. Determination of Stefan Boltzman constant.

10. Determination of heat transfer rate in drop and film wise condensation.
11. Determination of critical heat flux.
12. Determination of Thermal conductivity of liquids and gases.
13. Investigation of Lambert's cosine law.

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

Course Title: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):0:0:2	**Credits:1**
Type of Course: PRACTICAL	**Course Code: R24MESC04**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Students should possess basic knowledge of Engineering Mathematics, Statistics, Programming (C/Python/MATLAB), and fundamental concepts of Artificial Intelligence and Machine Learning. Familiarity with Linear Algebra, Probability, Optimization techniques, Signal Processing, Control Systems, Robotics, and data analysis/visualization tools will help in understanding and performing the experiments effectively.	

Course Objectives

After completion of this course, the student will be able to:

1. Understand the fundamentals of Artificial Intelligence, Machine Learning, and intelligent systems.
2. Acquire, preprocess, visualize, and analyze engineering datasets for AI/ML applications.
3. Apply feature extraction and dimensionality reduction techniques for effective data analysis.
4. Develop and evaluate classification and regression models using suitable machine learning algorithms.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO5**	**PO11**	**PSO1**	**BT**
Analyze engineering datasets using appropriate AI and Machine Learning techniques.	3	3	2	3	1	3	L4
Extract relevant features and perform dimensionality reduction for efficient model development.	3	3	2	3	1	3	L3
Develop and evaluate machine learning models for classification and regression problems.	3	3	3	3	1	3	L6
Apply optimization and intelligent control techniques such as Genetic Algorithms, Reinforcement Learning, and Neural Networks to engineering systems.	3	3	3	3	1	3	L3

List of Experiments:

1. To study supervised/unsupervised/Reinforcement learning approach.
2. To acquire, visualize and analyze the data set (from time-domain/ frequency-domain/ etc.) .
3. To extract features from given data set and establish training data.
4. To select relevant features using suitable technique.
5. To use PCA for dimensionality reduction.
6. To classify features/To develop classification model and evaluate its performance (any one classifier).
7. To develop regression model and evaluate its performance (any one algorithm).
8. Markov process for modelling manufacturing processes.
9. Reinforced Learning for optimizing engineering designs / Robot Guidance and Navigation.
10. GA for optimization of multi-dimensional function / path planning in robotics.
11. NN for parameter and model identification / tuning of Control Algorithms.

ADVANCED APTITUDE AND COMMUNICATION SKILLS

Course Title: ADVANCED APTITUDE AND COMMUNICATION SKILLS	**YEAR -III SEM-II**
Teaching Scheme (L:T:P): 0:0:2	**Credits: 01**
Type of Course: Lecture / Skill Enhancement Course	**Course Code: R24HS09**
Continuous Internal Evaluation: 30 Marks	**Semester End Exam: 70 Marks**
Pre requisites: Basic Mathematics, Communicative English, Quantitative Aptitude and Logical Reasoning fundamentals.	

Course Objectives:
- To develop quantitative aptitude skills covering arithmetic, percentages, ratio, averages, profit and loss, interest, and data interpretation for placements.
- To strengthen logical reasoning and analytical problem-solving through coding-decoding, puzzles, seating arrangements, syllogisms and data sufficiency.
- To impart basic mathematics – geometry, mensuration, trigonometry – for campus recruitment and competitive examinations.
- To develop professional communication skills including spoken English, workplace communication, email writing, customer interaction and digital communication.
- To prepare students for placement interviews through Versant test practice, mock interviews, presentation skills, personality development and workplace etiquette.

Course Outcomes:
After completing the course, the student should be able to

CO	PO1	PO2	PO6	PO9	PO10	BT Level
CO1: Apply quantitative aptitude concepts to solve problems related to arithmetic, percentages, ratio, averages, profit and loss, interest, and data interpretation.	2	3	-	2	3	L3
CO2: Analyze and solve logical reasoning and analytical problems involving coding-decoding, puzzles, seating arrangements, syllogisms and data sufficiency.	2	3	-	2	3	L4
CO3: Apply mathematical and analytical techniques to solve campus recruitment and competitive examination problems efficiently.	2	3	-	2	3	L3
CO4: Develop professional communication skills including spoken English, workplace communication, email writing, customer interaction and digital communication.	1	-	2	3	3	L3
CO5: Demonstrate employability skills, presentation abilities, interpersonal communication, workplace etiquette, personality development and interview readiness for corporate careers.	1	-	2	3	3	L3

SYLLABUS

PART – A : APTITUDE, REASONING & ANALYTICAL SKILLS

Unit – I

Quantitative Aptitude & Problem Solving:

Percentages, Ratio and Proportion, Averages, Profit and Loss, Simple and Compound Interest, Time and Work, Pipes and Cisterns, Time-Speed-Distance, Boats and Streams, Permutations and Combinations, Probability. Practice Activities: Shortcut techniques, aptitude worksheets, quantitative mock tests, company-level aptitude practice and speed calculation exercises. **-CO1**

Unit – II

Logical Reasoning & Data Interpretation:

Coding-Decoding, Blood Relations, Number Series, Seating Arrangements, Syllogisms, Puzzles, Statement and Conclusions, Logical Sequences, Data Sufficiency, Non-Verbal Reasoning, Tables, Charts, Graphs and Data Interpretation techniques. Practice Activities: Reasoning mock tests, puzzle-solving sessions, sectional practice tests, analytical exercises and company-specific reasoning assessments. **-CO2**

Unit – III

Basic Mathematics for Placements:

Geometry basics, Triangles, Circles, Trigonometric ratios, Heights and Distances, Angles, Mensuration concepts and Mathematical reasoning frequently used in aptitude examinations. Practice Activities: Formula applications, trigonometry exercises, mathematical problem-solving and placement-oriented practice sessions. **-CO3**

PART – B : PROFESSIONAL COMMUNICATION & EMPLOYABILITY SKILLS

Unit – IV

Professional & Corporate Communication Skills:

Sentence Structure, Vocabulary Development, Spoken English, Pronunciation, Fluency Development, Grammar Correction, Listening Skills, Workplace Communication, Customer Handling, Telephone Etiquette, Voice Modulation, Active Listening, Chat Communication and Professional Email Writing. Practice Activities: Speaking practice, pronunciation drills, workplace conversations, mock voice calls, email drafting, role-play activities and communication fluency sessions. **-CO4**

Unit – V

Employability, Personality & Interview Skills:

Versant Test Pattern, Listening Comprehension, Reading Fluency, Sentence Mastery, Interpersonal Skills, Teamwork, Workplace Etiquette, Presentation Skills, Personality Development, Self-Introduction Techniques, HR Interview Preparation, Confidence Building and Professional Grooming. Practice Activities: Versant mock tests, mock interviews, presentation activities, teamwork exercises, self-introduction practice, placement mock drives and workplace etiquette sessions. **-CO5**

Text Books:

1. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishing.
2. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press.
3. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press.

References:

1. M. Tyra, Magical Book on Quicker Maths, BSC Publishing.
2. S.P. Bakshi, Objective General English, Arihant Publications.
3. Edgar Thorpe, Test of Reasoning, Pearson Education.
4. Web Resource: IndiaBix Aptitude and Reasoning – https://www.indiabix.com
5. Web Resource: PrepInsta Placement Preparation – https://prepinsta.com
6. Web Resource: British Council English Learning – https://learnenglish.britishcouncil.org

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CONSTITUTION OF INDIA

Course Title: CONSTITUTION OF INDIA	**YEAR -III SEM-II**
Teaching Scheme (L:T:P): 2:0:0	**Credits: -**
Type of Course: Lecture	**Course Code: R24MC05**
Continuous Internal Evaluation: 30 Marks	**Semester End Exam: 70 Marks**
Pre requisites: The prerequisites for the Indian Constitution include a strong belief in democracy, the rule of law, and the importance of protecting fundamental rights.	

COURSE OBJECTIVES:

1. To Enable the student to understand the importance of constitution
2. To understand the structure of executive, legislature and judiciary
3. To understand philosophy of fundamental rights and duties
4. To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
5. To understand the central and state relation financial and administrative.

Course Outcomes (COS)	Mapping with POs and PSOs						
	PO1	PO2	PO6	PO7	PO8	PO9	BT LEVEL
Understand the fundamentals of the Indian Constitution	2	1	2	3	---	1	L2
Explain the structure and functions of the Union Government	2	2	3	3	1	2	L2
Analyze the roles of State Government and administration	2	2	2	3	1	2	L4
Understand the framework and significance of local governance	2	2	3	3	2	2	L3
Explain the role of Election Commission and welfare commissions	2	2	3	3	---	1	L2

SYLLABUS

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy. **COS-CO1**

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions; **COS-CO2**

UNIT-III

State Government and its Administration Governor - Role and position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions **COS-CO3**

UNIT-IV

A Local Administration - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Panchayati Raj: Functions PRI: Zilla Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy **COS-CO4**

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women

COS-CO5

References:

1. Durga Das Basu, Introduction to the Constitution of India, 12th edition Prentice Hall of India Pvt. Ltd. New Delhi 2011.
2. Subash Kashyap, Indian Constitution, 2nd edition, National Book Trust, 2011.
3. J.A. Siwach, Dynamics of Indian Government & Politics, 2nd edition, Sterling Pub Private Ltd. 1990.
4. D.C. Gupta, Indian Government and Politics, 8th edition, Vikas Publishing House Pvt Ltd., 2015.
5. H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication), 2015.
6. J.C. Johari, Indian Government and Politics Hans, 13th edition, Shoban Lal & Co.2012.
7. J. Raj Indian Government and Politics, 1st edition, SAGE Texts Publication, 2008.
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, 3rd edition, Lexis Nexis Publications, 2008.
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right),

   Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-resources:

1. www.nptel.ac.in/courses/109104074/8
2. www.nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

CRYOGENICS

Course Title: CRYOGENICS	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE2.1**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Basic knowledge of thermodynamics, heat transfer, fluid mechanics, and refrigeration & air-conditioning systems. Understanding of material properties at low temperatures, gas laws, and engineering physics is helpful for studying cryogenic systems and liquefaction processes.	

Course Objectives:

1. 1 To interpret the scope and history of cryogenicsm, the properties of materials at low temperature applying fundamental knowledge.
2. 2 To apply the knowledge of low temperature production methods to interpret and analyse different liquefaction systems. To gain knowledge about the critical components involved in liquefaction.
3. To apply the knowledge of ideal refrigeration techniques, to interpret and analyse common cryogenic refrigeration systems. To apply some of the novel cryogenic refrigeration methods.
4. To illustrate various cryogenic fluid storage and transport systems and to evaluate their performance applying fundamental concepts
5. To interpret the different cryogenic instrumentation and to illustrate cryo pumping.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Interpret the scope and history of cryogenics, the properties of materials at low temperature applying fundamental knowledge.	3	2	2	2	-	3	L2, L3
Apply the knowledge of low temperature production methods to interpret and analyse different liquefaction systems. To gain knowledge about the critical components involved in liquefaction.	3	3	3	3	-	3	L3, L4
Apply the knowledge of ideal refrigeration techniques, to analyse common cryogenic refrigeration systems. To interpret some of the novel cryogenic refrigeration methods.	3	3	3	3	-	3	L3, L4
Illustrate various cryogenic fluid storage and transport systems and to evaluate their performance applying fundamental concepts	3	3	3	3	2	3	L2, L3, L5
Interpret the different cryogenic instrumentation and cryo pumping.	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I

Introduction to Cryogenic Systems: Historical development, Applications of Cryogenics (Space, Food Processing, Super conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry). Low Temperature Properties: Properties of Engineering Materials (Mechanical properties, Thermal properties, Electric and Magnetic properties), Properties of Cryogenic fluids.

UNIT–II

Introduction to Liquefaction Systems: Ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System. Introduction to Cryogenic Refrigeration Systems: Magnetic Cooling, Stirling Cycle Cryo Coolers.

UNIT–III

Gas Liquefaction Systems: General liquefaction systems. Liquefaction systems for Neon, Hydrogen and Helium. Critical components of liquefaction systems.

UNIT–IV

Cryogenic Refrigeration Systems: Ideal refrigeration systems, Refrigeration using liquids and gases as refrigerant, Refrigerators using solids as working media.

UNIT-V

Cryogenic Fluid Storage and Transfer Systems: Cryogenic storage vessels and transportation. Thermal insulation and their performance at cryogenic temperatures, Super insulations, Vacuum insulation, Powder insulation. Cryogenic fluid transfer systems. Cryogenic Instrumentation: Pressure, flow-rate, liquid-level and temperature measurements. Types of Heat Exchangers used in cryogenic systems (only description with figure). Cryo Pumping Applications.

TEXT BOOKS:

1. J. H. Boll Jr, Cryogenic Engineering.
2. R. B. Scott, Cryogenic Engineering, Van Nostrand Co., 1959

REFERENCES:

1. Randal F.Barron, Cryogenic systems, McGraw Hill, 1986 R1 Klaus D.Timmerhaus and Thomas M.Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.

NANO TECHNOLOGY

Course Title: NANO TECHNOLOGY	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE2.2**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Fundamentals of material science, solid state physics, chemistry, and engineering mechanics. Basic understanding of crystal structures, atomic bonding, thermal properties, and manufacturing processes is essential for learning nanomaterials and their applications.	

Course Objectives:

1. To interpret the classification of nano structured Materials
2. To describe the unique properties of nano materials
3. To interpret the Synthesis Routes - Bottom up and Top-down approaches
4. To identify the tools to characterize nano materials
5. To illustrate the applications of nano materials

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Interpret the classification of nano structured Materials	3	2	2	2	-	3	L2, L3
Describe the unique properties of nano materials	3	2	2	1	-	3	L1, L2
Interpret the Synthesis Routes - Bottom up and Top-down approaches	3	2	3	2	-	3	L2, L3
Identify the tools to characterize nano materials	3	2	3	3	-	3	L1, L2
Illustrate the applications of nano materials	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I Introduction

History and Scope, Classification of Nano structured Materials, Fascinating Nanostructures, applications of nanomaterials, challenges and future prospects.

UNIT–II Unique Properties of Nano materials

Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations. Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

UNIT–III Synthesis Routes

Bottom-up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly. Top-down approaches: Mechanical alloying, Nano-lithography. Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

UNIT–IV Tools to Characterize nanomaterials

X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation

UNIT-V Applications of Nano materials

Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

TEXT BOOKS:

1. Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens.Wiley India Pvt. Ltd.
2. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
3. Nano Essentials- T.Pradeep/TMH

REFERENCES:

1. Solid State physics by Pillai, Wiley Eastern Ltd.
2. Introduction to solid state physics 7th edition by Kittel. John Wiley & sons (Asia) Pvt Ltd.

PRODUCT DESIGN AND DEVELOPMENT

Course Title: PRODUCT DESIGN AND DEVELOPMENT	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE2.3**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**

Pre requisites: Basic knowledge of engineering drawing, manufacturing processes, machine design, and material science. Understanding of design principles, production methods, and engineering economics helps in product design and development activities.

Course Objectives:

1. Apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development.
2. Generate, select, screen, and test concepts for new product design and development.
3. Apply the principles of product architecture and industrial design to design and develop new products.
4. Apply the principles of DFMA and Prototyping to design and develop new product.
5. Apply the concepts of economics principles sustainable product development and life cycle assessment.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development.	3	3	3	3	-	3	L3, L4
Select, screen, and test concepts for new product design and development.	3	3	3	3	-	3	L3, L4, L5
Apply the principles of product architecture and industrial design to design and develop new products.	3	3	3	3	-	3	L3, L6
Apply the principles of DFMA and Prototyping to design and develop new product.	3	3	3	3	2	3	L3, L6
Apply the concepts of economics principles sustainable product development and life cycle assessment.	3	3	3	3	2	3	L3, L4, L5

SYLLABUS

UNIT –I Introduction

A Generic Development Process – Adapting the Generic Product Development Process - Product Development Process Flows- Digital tools for product design– Identifying Customer Needs - Product Specifications: Establishing Target Specifications; Setting the Final Specifications.

UNIT–II Concept Generation

Concept Generation: The Activity of Concept Generation - Concept Selection: Concept Screening; Concept Scoring – Concept Testing – Concept innovation using TRI

UNIT–III Product Architecture

Implications of the Architecture; Establishing the Architecture; Delayed Differentiation; Platform Planning; Related System-Level Design Issues – Industrial Design: Assessing the Need for Industrial Design; Impact of Industrial Design; The Industrial Design Process; Management of the Industrial Design Process; Assessing the Quality of Industrial Design.

UNIT–IV DFM and Prototyping

Design for Manufacturing: Estimate the Manufacturing Costs; Reduce the Costs of Components; Reduce the Costs of Assembly; Reduce the Costs of Supporting Production; Consider the Impact of DFMA– Prototyping: Type; Uses; Principles; Technologies; Planning for Prototypes.

UNIT-V Product Development Economics

Elements of Economic Analysis; Economic Analysis Process – sustainable product development: framework and metrics – life cycle assessment of a product: stages and impact.

TEXT BOOKS:

1. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.
2. Karl, T. Ulrich and Steven, D. Eppinger,

REFERENCES:

1. Belz A., 36-Hour Course: <Product Development= McGraw-Hill, 2010.
2. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
3. Pugh S., <Total Design – Integrated Methods for successful Product Engineering=, Addison Wesley Publishing, 1991.
4. Rosenthal S., <Effective Product Design and Development=, Business One, 1992.
5. Silva, A., Handbook of Research on Trends in Product Design and Development: Technological and Organizational Perspectives: Technological and Organizational Perspectives, IGI Global, 2010.
6. Devdas Shetty, <Product design for Engineers=, Cengage Learning

THERMAL MANAGEMENT OF ELECTRONIC SYSTEMS

Course Title: THERMAL MANAGEMENT OF ELECTRONIC SYSTEMS	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE2.4**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Fundamentals of heat transfer, thermodynamics, fluid mechanics, and basic electronics. Knowledge of conduction, convection, radiation, and cooling systems is necessary for analyzing thermal management in electronic equipment.	

Course Objectives:

1. To interpret the basics of heat transfer and analyze heat transfer through fins
2. To analyze the basics of convection and radiation modes of heat transfer.
3. To illustrate concepts the thermal analysis of printed circuit boards and their cooling.
4. To analyze the principles of two-phase cooling and heat pipes.
5. To interpret knowledge about the thermoelectric coolers.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Interpret the basics of heat transfer and analyze heat transfer through fins	3	3	2	3	-	3	L2, L4
Analyze the basics of convection and radiation modes of heat transfer.	3	3	2	3	-	3	L4
Illustrate concepts the thermal analysis of printed circuit boards and their cooling.	3	2	3	3	-	3	L2, L3
Analyze the principles of two-phase cooling and heat pipes.	3	3	3	3	-	3	L4
Interpret knowledge about the thermoelectric coolers.	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I Introduction of Heat Transfer and Conduction

Modes – Conduction, Convection and Radiation – Basic Laws – Applications of Heat Transfer Basics of Conduction –Conduction equation – Thermal analogy – Lumped heat capacity analysis - Heat conduction with phase change - Thermal Resistance – Extended Surfaces – Uniform cross section fins – Fin efficiency – Selection and design of fins.

UNIT–II Convection and Radiation

Forced and Free Convection – Heat transfer coefficient - Parameters effecting heat transfer – Thermal Properties of fluids - Combined Modes, Radiation– Stefan- Boltzmann Law – Kirchoff's law and Emissivity – Radiation between Black Isothermal Surfaces – Radiation between Grey Isothermal Surfaces – Extreme Climatic conditions - Radiation at normal ambient. Temperature measurement and its Instrumentation.

UNIT–III Printed Circuit Boards and Cooling

Chip packaging – thermal Resistance – Board Cooling methods – Board thermal Analysis – Equivalent thermal Conductivity Air Cooling – Fans – Heat transfer Enhancement – Air handling systems – Blowers. Single Phase Cooling – Coolant Selection – Natural Convection – Forced Convection - Air Cooling - Convective cooling in small systems – Forced cooling in medium and large systems – Liquid cooling in high power modules – Case Studies.

UNIT–IV Two Phase Cooling and Heat pipes

Direct Immersion Cooling – Basics of Pool Boiling – Enhancement of Pool Boiling – Flow Boiling Heat Pipes – Operation Principles – Useful Characteristics – Operating Limits and Temperatures – Operation Methods – Applications – Micro Heat Pipes.

UNIT-V Thermo Electric coolers

Basics theories – Thermo electric effect – Operation Principles Phase change materials, Thermal Interface materials, Heat Spreaders and Heat Sinks – Working Principles, Mini and Micro Channels. Use of nano fluids in electronic cooling.

TEXT BOOKS:

1. Thermal Analysis and Control of Electronic Equipment – Allan D. Kraus and Avram BarCohen, McGraw Hill, New York, NY, 1983.
2. Fundamentals of Microelectronics Packaging – Ed: Rao Tummala, McGraw Hill, New York, NY, 2001.

REFERENCES:

1. Packaging of Electronic Systems – James W. Dally, McGraw Hill, New York, NY, 1990

OPERATIONS MANAGEMENT

Course Title: OPERATIONS MANAGEMENT	YEAR -III SEM-II
Teaching Scheme(L:T:P):3:0:0	Credits: 3
Type of Course: Lecture	Course Code: R24MEPE2.5
Continuous Internal Evaluation:30Marks	Semester End Exam:70 Marks

Pre requisites: Basic understanding of industrial engineering, production processes, statistics, and engineering mathematics. Knowledge of manufacturing systems, inventory concepts, and quantitative techniques is useful for studying operations and production management.

Course Objectives:

1. To develop the skills of forecasting, production systems and Aggregate Planning.
2. To provide the knowledge of materials management and scheduling policies
3. To understand the principles of inventory control, MRP and contemporary management techniques.
4. To guide in learning the key concepts and issues of quality management in both manufacturing and service organizations.
5. To develop the knowledge and skill to find out the optimum solutions for a given situation using optimization techniques.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Apply appropriate forecasting techniques & Aggregate planning methods	3	3	3	3	-	3	L3, L4
Learn Materials management analysis and scheduling policies	3	2	2	2	-	3	L1, L2
Learn about the inventory control techniques, MRP and contemporary management techniques.	3	2	3	2	2	3	L1, L2, L3
Apply quality management principles proposed by Taguachi, Juran & Demigs	3	3	3	3	-	3	L3, L4
Apply optimization to LP model & transportation and assignment problems	3	3	3	3	2	3	L3, L4

SYLLABUS

UNIT –I

Forecasting: Introduction, types of forecasting and their uses, General principles of forecasting, forecasting techniques: qualitative and quantitative methods of Forecasting.

Production Systems: Types of production systems: job, batch, mass and flow type production.

Aggregate Planning: Introduction, aggregate planning strategies, aggregate planning methods, problems

UNIT–II

Scheduling: Introduction, difference with loading, scheduling policies, techniques, standard scheduling methods.

Materials Management: Introduction, functions of materials management, inventory, inventory management, types of inventories, Selective inventory control techniques: ABC analysis, VED analysis.

UNIT–III

Inventory Control: P and Q Systems, Basic Economic Order Quantity model, Price break model, assumptions and problems

Material Requirement Planning: Introduction, Inputs, outputs and MRP logic.

Contemporary management techniques: Introduction to Lean, JIT, ERP and Supply chain Management.

UNIT–IV

Quality Management: Quality engineering, Taguchi Principles, SQC – X bar, p and c charts, problems, Juran‘s principles Introduction to quality acceptance sampling. Deming‘s Philosophy, Introduction to Total quality management, Quality Function Deployment, Introduction to six sigma and ISO 9000 2015 standards.

UNIT-V

Optimization: Linear Programming – Graphical and simplex method – problems, Demonstration of Transportation and Assignment Models, Travelling Salesman problem.

TEXT BOOKS:

1. Modern Production/ operations managements / Baffa & Rakesh Sarin
2. Operations Management – an Integrated Approach, International student Version, R. Dan Reid and Nada R. Sanders, John Wiley & Sons
3. Production and Operations management by K. C. Jain, Wiley
4. Operations Management by William J. Stevenson, McGraw-Hill Companies 2015

5. SOperations Management by Jay Heizer , Barry Render, Chuck Munson , Amit Sachan Twelfth Edition, Pearson, 2017

REFERENCES:

1. Maynard's Industrial Engineering Handbook, Kjell B. Zandin, Fifth Edition 2001, The McGrawHill Companies, Inc.
2. Operations Management S.N. Chary.
3. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.

INSTRUMENTATION AND CONTROL SYSTEMS

Course Title: INSTRUMENTATION AND CONTROL SYSTEMS	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE3.1**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Basic knowledge of engineering measurements, physics concepts related to force, pressure and temperature, fundamentals of electrical and electronics engineering, and understanding of mechanical systems and control concepts.	

Course Objectives:

1. To learn the basic concepts of measurement systems, instrument characteristics, and principles of displacement measurement using various transducers.
2. To understand the operating principles and classifications of temperature and pressure measuring instruments used in engineering applications.
3. To learn the concepts involved in level, flow, and speed measurement techniques and their industrial applications.
4. To know the basic principles and methods used for measuring acceleration, vibration, stress, and strain using different instruments and gauges.
5. To understand the concepts of force, torque, and power measurement along with the fundamentals of control systems and their applications.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Outline the principles of measurement systems and construction of various transducers for displacement measurement	3	2	2	2	-	3	L2
Classify the different types of temperature and pressure measuring devices	3	2	2	2	-	3	L2
Experiment the working principles of level, flow and speed measuring instruments	3	3	3	3	-	3	L3, L4
Utilize the principles of various types of acceleration and vibration, stress and strain and humidity measuring instruments	3	3	3	3	-	3	L3
Illustrate the operating principles of force, torque and power measurements and different types of control systems	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I Basic Principles of Instruments and Measurement

Definition–Basic principles of measurement-measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics– sources of error, classification and elimination of error. Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

UNIT–II Measurement of Temperature and Pressure

MEASUREMENT OF TEMPERATURE: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermistor – thermocouple – pyrometers. **MEASUREMENT OF PRESSURE:** Units – classification – different principles used. Manometers, bourdon pressure gauges, bellows – diaphragm gauges. Low pressure measurement – thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT–III Measurement of Flow, Level and Speed

MEASUREMENT OF LEVEL: Direct method – indirect methods – capacitive, ultrasonic, magnetic, cryogenic fuel level indicators – bubbler level indicators. FLOW MEASUREMENT: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA). **MEASUREMENT OF SPEED:** Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer

UNIT–IV Stress and Strain Measurements

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle**.**
STRESS STRAIN MEASUREMENTS: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.

UNIT-V Force and torque measurement

MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, torsion meters, dynamometers.
ELEMENTS OF CONTROL SYSTEMS: Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.

TEXT BOOKS:

1. Measurement Systems: Applications & design / D.S Kumar/
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, Pearson

REFERENCES:

1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill.
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra&K.K.Choudhary/TMH

NON- DESTRUCTIVE EVALUATION

Course Title: NON- DESTRUCTIVE EVALUATION	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE3.2**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Fundamentals of material science, properties of engineering materials, manufacturing processes, and basic understanding of stress, strain, defects, and quality inspection methods..	

Course Objectives:

1. To learn basic concepts of non-destructive testing and industrial applications.
2. To understand the elements of ultrasonic test and limitations of ultrasonic test.
3. To learn the concepts involved in the liquid penetrant test and eddy current test.
4. To know the basic principles and operating procedures of magnetic particle testing.
5. To understand the basic concepts involved in the infrared and thermal testing

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Understand the concepts of various NDE techniques and the requirements of radiography techniques and safety aspects.	3	2	2	2	-	3	L2
Interpret the principles and procedure of ultrasonic testing	3	2	3	2	-	3	L2, L3
Understand the principles and procedure of Liquid penetration and eddy current testing	3	2	3	2	-	3	L2, L3
Illustrate the principles and procedure of Magnetic particle testing	3	2	3	2	-	3	L2, L3
Interpret the principles and procedure of infrared testing and thermal testing	3	3	3	3	2	3	L2, L3, L4

SYLLABUS

UNIT –I

Introduction to non-destructive testing and industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions. Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography, neutron ray radiography

UNIT–II

Ultrasonic test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT–III

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness, DPI, FPI,Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing

UNIT–IV

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test

UNIT-V

Infrared And Thermal Testing: Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography, tomography-Contact and non-contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behaviour of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

TEXT BOOKS:

1. Nondestructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers.
2. Ultrasonic testing of materials/ H KrautKramer/Springer
3. Nondestructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4. Nondestructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

REFERENCES:

1. Ultrasonic inspection training for NDT/E.A.Gingel/PrometheusPress,

SMART MATERIALS

Course Title: SMART MATERIALS	YEAR -III SEM-II
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE3.3**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Basic knowledge of material science, composite materials, nanotechnology concepts, mechanical behavior of materials, and engineering mechanics.	

Course Objectives:

1. To learn the basic concepts, classifications, reinforcement materials, and applications of composite materials used in engineering fields.
2. To understand different aerospace materials, their properties, and applications under extreme environments such as cryogenic and space conditions.
3. To learn the concepts involved in macro-mechanical analysis of lamina, including Hooke's law, stiffness matrix, and elastic constants of composite materials.
4. To know the basic principles, classifications, properties, and applications of functionally graded materials and shape memory alloys.
5. To understand the fundamental concepts, properties, advantages, limitations, and applications of nanomaterials in advanced engineering systems.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Classify the composite materials and identify the applications	3	2	2	2	-	3	L2
Identify the aerospace materials and their applications	3	2	2	2	-	3	L1, L2
Explain macro-mechanical analysis of a lamina	3	3	2	3	-	3	L2, L4
Interpret the functionally graded materials and their properties	3	2	3	2	-	3	L2, L3
Illustrate types of nano materials and their properties	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I Introduction to Composite Materials

Introduction, classification: polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber- reinforced composites and nature-made composites, and applications

REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and boron carbide fibres.

UNIT–II Aerospace Materials

Metallic materials- super alloys, Aluminium, Magnesium, titanium and Nickel based alloys and intermetallics, High temperature polymers, Materials for cryogenic application, Materials for space environment, Evaluation of materials for extreme environment, Materials processing and manufacturing in zero gravity.

UNIT–III Macromechanical Analysis of a Lamina

Introduction, generalized Hooke's law, reduction of Hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.

UNIT–IV Functionally Graded Materials

Types of functionally graded materials-classification different systems-preparation-properties and applications of functionally graded materials.

SHAPE MEMORY ALLOYS: Introduction-shape memory effect-classification of shape memory alloys composition-properties and applications of shape memory alloys.

UNIT-V Nano Materials

Introduction-properties at nano scales-advantages & disadvantages applications in comparison with bulk materials (nano – structure, wires, tubes, composites). state of art nano advanced- topic delivered by student.

TEXT BOOKS:

1. Nano material /A.K. Bandyopadyay/New age Publishers
2. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
3. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press

REFERENCES:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van Nostrand Rainfold,NY 1969
3. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience, New York, 1980
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /Autar K.Kaw /CRC Press

AUTOMOBILE ENGINEERING

Course Title: AUTOMOBILE ENGINEERING	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE3.4**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Understanding of thermodynamics, internal combustion engines, heat transfer, fluid mechanics, and fundamentals of automotive systems.	

Course Objectives:

1. To study the advanced engine technologies
2. To learn various advanced combustion technologies and its benefits
3. To learn the methods of using low carbon fuels and its significance
4. To learn and understand the hybrid and electric vehicle configurations
5. To study the application of fuel cell technology in automotive

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Discuss the latest trends in engine technology	3	2	2	2	2	3	L2
Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment.	3	3	2	3	2	3	L2, L4
Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.	3	3	3	3	2	3	L4
Discuss the working and energy flow in various hybrid and electric configurations.	3	2	3	2	2	3	L2, L3
Analyzing the need for fuel cell technology in automotive applications.	3	3	3	3	2	3	L4

SYLLABUS

UNIT –I Advanced Engine Technology

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

UNIT–II Combustion Technology

Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

UNIT–III Low Carbon Fuel Technology

Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward

UNIT–IV Hybrid and Electric Vehicle (Battery Powered)

Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward

UNIT-V Fuel Cell Technology

Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

TEXT BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6 , SPRINGER

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003 3.Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998.
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003. 5.James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

AUTOMATION IN MANUFACTURING

Course Title: AUTOMATION IN MANUFACTURING	**YEAR -III SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE3.5**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Basic knowledge of manufacturing processes, production engineering, machine tools, control systems, sensors, and industrial automation concepts.	

Course Objectives:

1. To understand the types and strategies and various components in Automated Systems.
2. To classify the types of automated flow lines and analyze automated flow lines.
3. To solve the line balancing problems in the various flow line systems with and without buffer storage.
4. To interpret different automated material handling systems, storage and retrieval systems and automated inspection systems.
5. To understand the principles of Adaptive Control systems and recognize the types of automated inspection techniques and their applications

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Understands the types and strategies and various components in Automated Systems.	3	2	2	2	-	3	L2
Classify the types of automated flow lines and analyze automated flow lines	3	3	3	3	-	3	L2, L4
Solves the line balancing problems in the various flow line systems with and without buffer storage	3	3	3	3	-	3	L3, L4
Interpret different automated material handling systems, storage and retrieval systems and automated inspection systems	3	2	3	2	2	3	L2, L3
Understand the principles of Adaptive Control systems and recognize the types of automated inspection techniques and their applications	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I

INTRODUCTION: Types and strategies of automation, pneumatic and hydrauliccomponents, circuits, automation in machine tools, power transmission in CNC machines, optical encoders, other sensors, mechanical feeding and tool changing and machine tool control.

UNIT–II

AUTOMATED FLOW LINES: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT–III

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

AUTOMATED INSPECTION: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision

UNIT–IV

AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT-V

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

TEXT BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover/ PE/PHI. Automation by W. Buekinsham.

REFERENCES:

1. Computer Control of Manufacturing Systems by Yoram Coren.
2. CAD / CAM/ CIM by Radhakrishnan. House, New Delhi,2/e, 2013.

FINITE ELEMENT METHODS

Course Title: **FINITE ELEMENT METHODS**	**YEAR -IV SEM-I**
Teaching Scheme (L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEPC22**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: Basic knowledge of Engineering Mathematics, Strength of Materials, and Engineering Mechanics.	

Course Objectives:

1. To illustrate basic principles of finite element analysis procedure.
2. To analyze the theory and characteristics of finite elements that represent engineering structures of trusses and beams.
3. To develop finite element modeling of two-dimensional stress analysis.
4. To analyze the finite modelling for high order and isoparametric elements.
5. To develop the usage of finite element method for the steady state heat transfer analysis

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Illustrate basic principles of finite element analysis procedure	3	2	-	-	-	3	L2
Analyze the theory and characteristics of finite elements that represent engineering structures of trusses and beams	3	3	-	2	-	3	L4
Develop finite element modeling of two-dimensional stress analysis	3	3	3	2	-	3	L5
Analyze the finite modelling for high order and isoparametric elements	3	3	2	2	-	3	L4)
Develop the usage of finite element method for the steady state heat transfer analysis	3	3	3	2	2	3	L5

SYLLABUS

UNIT-I

Introduction to finite element method, stress and equilibrium, strain –displacement relations, stress strain relations, plane stress and plane strain conditions, Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.

UNIT – II

Analysis of Trusses: Finite element modelling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT – III

Finite element modelling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axi-symmetric problems.

UNIT-IV

Higher order and isoparametric elements: One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements and numerical integration.

UNIT – V

Steady state heat transfer analysis: one dimensional analysis of a fin and two-dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis..

TEXTBOOK:

1. The Finite Element Methods in Engineering /SSRao/Pergamon.
2.

REFERENCES:

1. Finite Element Method with applications in Engineering / YM Desai, Eldho& Shah /Pearson publishers
2. An introduction to Finite Element Method /JNReddy/McGrawHill
3. The Finite Element Method for Engineers–KennethH.Huebner, Donald L. Dewhirst, Douglas E. Smith and TedG. Byrom/John Wiley & sons (ASIA)PteLtd.
4. Finite Element Analysis: Theory and Application with Ansys, Saeed Moaveniu, Pearson Education
5. Finite Element Methods / Chen
6. Finite Element Analysis: for students & Practicing Engineers / G.Lakshmi Narasaiah / BSP Books Pvt. Ltd.

HYBRID AND E-VEHICLES

Course Title: HYBRID AND E-VEHICLES	**YEAR -IV SEM-I**
Teaching Scheme (L:T:P):3:0:0	**Credits:2**
Type of Course: LECTURE	**Course Code: 24MEPC23**
Continuous Internal Evaluation:30Marks	**Semester EndExam: 70Marks**
Pre requisites: To effectively understand this course, students should have prior knowledge in Thermodynamics, Engineering Mechanics, Basic Electrical Engineering, and Engineering Mathematics.	

Course Objectives:

1. Foundational and advanced knowledge of hybrid and electric vehicles, focusing on system architecture, energy management, power electronics, vehicle dynamics, control strategies, and communication technologies

COURSE OUTCOMES	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Analyze the need for hybrid and electric vehicles and explain the architecture, components, operation modes, control strategies, and layout of HEVs, PHEVs, and EVs.	3	3	2	2	-	3	L3
Explain various types of batteries and energy storage devices, their characteristics, charging methods, and power electronic components used in electric and hybrid electric vehicle systems	3	2	-	-	-	3	L2
Analyze energy management strategies and apply design principles for component sizing, thermal management, and battery management in hybrid and battery electric vehicles	3	3	3	2	-	3	L5
Understand the construction, function, and types of vehicle subsystems including differential, axles, tires, suspension, steering, and braking systems, along with their role in vehicle control and safety	3	2	-	-	-	3	L2
Apply advanced control techniques and understand embedded systems, vehicle security, and communication protocols used in electric and hybrid electric vehicles	3	3	3	2	2	3	L3

SYLLABUS

UNIT–I

INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES

Hybrid Vehicles - Need for hybrid and electric vehicles - Series parallel architecture of Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components. Power Split devices for Hybrid Vehicles - Operation modes – Control Strategies for Hybrid Vehicle. Layout of an electric vehicle

UNIT–II

ENERGY STORAGE TECHNOLOGIES

Battery Technologies, Charging Methods, and Battery Management Systems

Battery Parameters- Different types of batteries – Lead Acid- Nickel Based-Sodium based Lithium based- Metal Air based. Battery charging - Quick Charging devices. Battery Management System.

Energy Storage and Power Conversion Technologies

Fuel cells, super capacitors, and their characteristics. Power Electronics-DC-DC converters, DC-AC inverters, and their applications in EV and HEV systems.

UNIT –III

DESIGN AND MANAGEMENT STRATEGIES

Energy Management Strategies (EMS)- Different EMS approaches (rule-based, optimization based, etc.) and their implementation. HEV Design-Sizing of components, power rating of motors and engines. BEV Design-Sizing of battery packs. Battery Management Systems (BMS)- Thermal Management-Cooling systems for batteries and electric motors.

UNIT–IV

TRANSMISSION, SUSPENSION AND VEHICLE CONTROL SYSTEM

Differential - Necessity and Working of LSD. Axles - Types of Rear Axle. Tires - Tire Construction, Radial Tires, Tire specification, Tire rotation. Wheel alignment and balancing Importance of Castor, Camber, Toe-in, Toe-out and balance weight. Suspension System Types of suspension systems – Mac Pherson strut and Wishbone. Vehicle Control: Steering system - Steering gear box and its types, Power Steering. Brake system - Necessity, Drum, Disc, Hydraulic, Parking and Power Brakes, ABS, EBD and Regeneration

UNIT–V

ADVANCED CONTROL & COMMUNICATION SYSTEMS

Automated embedded system and vehicle security system, Advanced Control Systems-Model Predictive Control (MPC), fuzzy logic, and advanced control techniques. Vehicle Networking and Communication-CAN bus, and communication protocols used in EVs and HEVs

TEXTBOOK:

1. Mi, Chris; Masrur, M. Abul; Gao, David Wenzhong. Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives. 2nd ed., Wiley, 2017. ISBN 13: 978-1118970560"Theory of Machines", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Ed 2006/
2. Husain, Iqbal. Electric and Hybrid Vehicles: Design Fundamentals. 3rd ed., CRC Press, 2021. ISBN-13: 978-0367693930.
3. Solanki, Chetan Singh. Electric and Hybrid Vehicles. 1st ed., McGraw Hill Education India, 2013. ISBN-13: 978-1259063882

REFERENCES:

1. Larminie, James; Lowry, John. Electric Vehicle Technology Explained. 2nd ed., Wiley, 2012. ISBN-13: 978-1119942733.
2. Kirpal Singh. Automobile Engineering – Volume I&II. 14th Edition, Standard Publishers Distributors, 2019. ISBN: 978-8180142420.
3. Pundir, B. P. (2021). Hybrid Electric Vehicles. Narosa Publishing House. ISBN: 9788184876924.

MANAGERIAL SKILLS FOR ENGINEERS

Course Title: MANAGERIAL SKILLS FOR ENGINEERS	**YEAR -IV SEM-I**
Teaching Scheme (L:T:P):2:0:0	**Credits:2**
Type of Course: LECTURE	**Course Code:R24HS12**
Continuous Internal Evaluation:30Marks	**Semester EndExam:70Marks**
Pre requisites: Basic knowledge of Engineering Management, Engineering Mathematics, and general awareness of Business Studies.	

Course Objectives:

1. Provide fundamental knowledge on Management, Administration, Organizational methodologies (L3)
2. Equip with the knowledge of long-term business value for the organization (L2)
3. Explain basics of human resource management & marketing required for organization(L3)
4. Analyses the PERT/CPM techniques for better Project Management. (L4)
5. Incorporate technology perspectives with Managerial practices(L2)

COURSE OUTCOMES	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Apply principles of management & designs of organization in practical world. (L3)	_	2	3	-	3	1	L3
Realize concepts of business value development for organizational growth. (L2)	_	2	2	-	3	1	L2
Provided awareness of human resource management and marketing concepts. (L3)	_	1	2	-	3	1	L3
Develop PERT/CPM Charts for projects of enterprise and estimate time & cost of project. (L3)	2	3	3	2	3	1	L3
Analysis of improved decision making with the implementation of technology in Management(L2)	2	3	2	2	3	1	L2

SYLLABUS

UNIT-I

INTRODUCTION TO MANAGEMENT: Management-Concept -Nature-Functions- Evolution of Management Thought -Principles of Management-Theories of Motivation- Managerial skills-Data driven Decision making-Leadership styles - Interpersonal skills- organizational structures.

UNIT – II

BUSINESS VALUE DEVELOPMENT: Business Environment-Building business value through Modernization-Business Analytics- Types-Principles of Value Engineering- Approaches and methods of Business value- Strategies for enhancing Business Value -Corporate Social Responsibility-SWOT analysis of Business

UNIT – III

HUMAN RESOURCES MANAGEMENT & MARKETING MANAGEMENT:

Human Resource Management- Definition and Meaning –Managerial and Operative functions-Job Evaluation and Merit rating- Negotiation skill- Employee performance appraisal. **Marketing Management**: Concept- Meaning - Nature-Functions of Marketing- Marketing Mix- Marketing Strategies based on Product Life Cycle-Digital Marketing

UNIT-IV

PROJECT MANAGEMENT: Project Selection and criteria of choice-Project planning and control-Development of Network- Difference between Program Evaluation Review Technique and Critical Path Method- Identifying critical path-crashing (simple problems).

UNIT – V

Technology in Management: AI (Artificial Intelligence) in Management-Finance, Operations,Human Resource- Development Phases of AI for Management Support-Benefits, Challenges and considerations-Best Practices for AI Implementation-Case Examples

TEXTBOOK:

- 1. Management Science by Aryasri; Publisher: Tata McGraw Hill, 2009
- L.M. Prasad, Principles and Practice of Management.

REFERENCES:

6. Robins, Stephen P., *Fundamentals of Management,* Pearson, India.
7. Kotler Philip & Keller Kevin Lane: Marketing Management 12/e, PHI, 2007
8. Koontz &Weihrich: *Essentials of Management*, 6/e, TMH, 2007
9. Valuing a Business, 5th Edition : The Analysis and Appraisal of Closely Held Companies, Shannon P.Pratt
10. Artificial Intelligence Concepts for Management, Paperback, Katzan Harry Jr, 2023

Web links:

1. www.managementstudyguide.com
2. www.citehr.com
3. www.nptel.ac.in/courses/122106032
4. https://nptel.ac.in/courses/110/106/110106145/

COMPUTATIONAL FLUID DYNAMICS & MECHATRONICS LAB

Course Title: Computational Fluid Dynamics & Mechatronics Lab	**YEAR -IV SEM-I**
Teaching Scheme(L:T:P):0:0:2	**Credits:1**
Type of Course: PRACTICAL	**Course Code: R24MESC05**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Good knowledge of Mechanics of solids, CAD, FEM	

Course Objectives:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO9	P11	PS01	PS02	BT LEVEL
To solve problems of fluid mechanics and heat transfer by writing programs in C-language and MATLAB.	3	2	-	2	3	-	1	2	2	2	L3
To solve ANSYS-FLUENT build geometry, mesh that geometry, Perform CFD Method on the mesh, performs the calculation, and post-processes the results.	3	3	2	3	3	1	1	2	3	3	L4
To interpret the validation of the numerical result by comparison with known analytical results.	2	3	1	3	2	1	2	3	2	2	L5
To analyze the numerical result by invoking the physical principles of fluid mechanics and heat transfer.	3	3	2	3	2	2	1	2	3	2	L4
To solve Elliptical, Parabolic, Partial and Hyperbolic partial differential equations.	3	2	1	2	2		1	2	2	1	L3

Lab Experiments

Computational Fluid Dynamics Lab

Using ANSYS-FLUENT solve the following problems of heat transfer analysis

1. Steady state conduction
2. Lumped heat transfer
3. Convective heat transfer – Internal flow (study both velocity and thermal boundary layers)
4. Convective heat transfer – External flow (study both velocity and thermal boundary layers)
5. Radiation heat transfer–Emissivity
6. Heat transfer analysis in heat exchanger

Mechatronics Lab

1. DYNA 1750 Transducers Kit:- Characteristics of LVDT
2. Principle & Characteristics of Strain Gauge
3. Characteristics of Summing Amplifier
4. Characteristics of Reflective Opto Transducer
5. Ladder programming for Water level control and Lift control Modules
6. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection

EMPLOYABILITY SKILLS-3 CORPORATE READINESS FOR IT

Course Title: Corporate Readiness for IT	YEAR -IV SEM-I
Teaching Scheme(L:T:P):0:0:2	Credits:1
Type of Course: PRACTICAL	Course Code: R24HS10
Continuous Internal Evaluation:30Marks	Semester End Exam:70Marks
Pre requisites: Students should possess basic knowledge of computer fundamentals, programming concepts, and logical problem-solving skills. Familiarity with any programming language such as C, C++, Java, or Python, along with basic understanding of web technologies, databases, internet concepts, and software tools will help students effectively learn advanced programming, web development, APIs, AI foundations, and project development methodologies.	

Course Objective

The course is designed to provide core engineering students with essential programming, web development, database, and AI fundamentals required for campus placements and entry-level software industry roles. It focuses on improving coding ability, analytical thinking, problem-solving skills, technical knowledge, and project development through practical and placement-oriented learning.

Course Outcomes (COs)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO9	P11	PS01	BT LEVEL
Apply programming and data structure concepts to solve campus placement coding problems	3	3	2	2	3	1	1	1	3	L3
Develop responsive frontend applications using modern web technologies	3	2	3	2	3	1	2	1	3	L6
Perform database operations and use SQL queries effectively in software applications.	3	2	2	2	3	1	1	1	3	L3
Use APIs, Git Hub workflows, and software development tools for application development	2	2	3	2	3	1	2	1	3	L3
Demonstrate foundational AI knowledge, project development skills, teamwork, and technical interview readiness.	2	2	2	2	2	1	3	1	2	L3

UNIT-I: ADVANCED PROGRAMMING & DSA FOUNDATIONS

This unit develops programming and analytical problem-solving skills through important programming concepts and data structures required for campus placements. Students learn recursion, time complexity analysis, arrays, linked lists, stacks, queues, hashing basics, trees overview, sorting, searching algorithms, and coding optimization techniques used in technical interviews.

Hands-on Skills

- Solving coding problems
- Implementing data structures
- Complexity analysis
- Competitive coding practice

UNIT-II: WEB DEVELOPMENT FOUNDATIONS

This unit introduces frontend web development technologies and responsive application design. Topics include HTML5, CSS3, JavaScript fundamentals, DOM manipulation, responsive layouts, API concepts, and introductory React development for modern user interface creation.

Hands-on Skills

- Building responsive web pages
- Creating interactive UI components
- Working with forms and APIs
- Developing small frontend projects

UNIT-III: DATABASES & SQL FUNDAMENTALS

This unit covers important database concepts required for software development and placement preparation. Students learn database basics, SQL queries, CRUD operations, database connectivity concepts, and introduction to backend integration.

Hands-on Skills

- Writing SQL queries
- Performing CRUD operations
- Connecting applications with databases
- Database practice exercises

UNIT-IV: APIs, GIT & SOFTWARE TOOLS

This unit introduces API fundamentals and modern software development tools. Topics include REST API concepts, API testing basics, Git/GitHub workflows, debugging tools, version control, and simple deployment fundamentals.

Hands-on Skills

- Connecting frontend with APIs
- Git workflow management
- API testing practice
- Deploying simple applications

UNIT-V: AI FOUNDATIONS & PROJECT DEVELOPMENT

This unit introduces foundational AI concepts and project development methodologies. Topics include datasets, NumPy and Pandas basics, AI APIs, prompt engineering basics, teamwork, documentation practices, collaborative project execution, resume preparation, and technical interview readiness.

Hands-on Skills

- Working with datasets
- Using AI APIs
- Building simple AI-enabled applications
- Team collaboration and presentation

Text Books

1. Reema Thareja, *Programming in C*, Oxford University Press, India.
2. Jon Duckett, *HTML & CSS: Design and Build Websites*, Wiley India Publications.
3. Ramez Elmasri and Shamkant B. Navathe, *Fundamentals of Database Systems*, Pearson India.

Reference Books

1. Narasimha Karumanchi, *Data Structures and Algorithms Made Easy*, CareerMonk Publications, India.
2. Eloquent JavaScript by Marijn Haverbeke, *A Modern Introduction to Programming*, No Starch Press.
3. Sumita Arora, *Computer Science with Python*, Dhanpat Rai Publications.

Web Links

1. Geeks for Geeks Programming & DSA
2. MDN Web Docs
3. W3Schools Learning Platform

INDUSTRIAL INTRENSHIP

Course Title: INDUSTRIAL INTRENSHIP	**YEAR -IV SEM-I**
Teaching Scheme(L:T:P):0:0:0	**Credits:2**
	Course Code: R24IN02

VALUE EDUCATION

Course Title: Value Education	YEAR -IV SEM-I
Teaching Scheme(L:T:P):2:0:0	**Credits:2**
Type of Course: PRACTICAL	**Course Code: R24MC07**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70Marks**
Pre requisites: Students should possess basic awareness of moral values, social responsibility, environmental issues, and ethical behavior in daily life. Familiarity with human values, communication skills, teamwork, and fundamental constitutional and societal concepts will help students understand the course effectively and participate actively in discussions, assignments, and community-oriented activities.	

Course Objective

1. To introduce the concepts, need, objectives, and significance of Value Education and to understand the role of teachers and educational systems in developing human values.
2. To develop essential personal and interpersonal values such as honesty, integrity, empathy, teamwork, punctuality, and positive thinking for a balanced life.
3. To create awareness about human rights, national integration, peace, non-violence, enlightened citizenship, and the role of media in value building.
4. To understand ecological balance, environmental conservation, sustainability, and the interdependence between living and non-living systems.
5. To inculcate social responsibility, professional ethics, leadership qualities, consumer awareness, and personality development for ethical professional practice and responsible citizenship.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO9	P11	PS01	BT LEVEL
Explain the concept, objectives, types, and importance of Value Education along with the role of teachers and educational systems in value development.	1	1	1	1	1	2	2	1	1	L2
Demonstrate personal and interpersonal values such as honesty, teamwork, empathy, punctuality, commitment, and positive thinking in day-to-day life.	1	1	1	1	1	2	3	1	1	L3
Interpret human rights, national integration, peace, non-violence, and enlightened citizenship values for responsible social behavior.	1	2	1	1	1	3	2	1	1	L2
Analyze environmental and ecological issues and develop awareness towards conservation, sustainability, and balanced ecosystems.	2	3	2	2	1	3	2	1	1	L4

Apply social, ethical, and professional values including engineering ethics, leadership qualities, consumer responsibilities, and personality development in professional and social life.	2	2	2	1	1	3	3	2	1	L3

UNIT 1:

Introduction of Value Education

Introduction, Definition, Need for Value Education, Other reasons, Objectives of Value Education, Types of Values, Categorization of Values, Factors Influencing the Learning of Values, Value Education in India, Implementing the above in the school systems under the Central control, Initiatives from the Planning Commission, Approaches to teaching VE, The role of Teachers.

Assignment- 1

Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? What have been your achievements and shortcomings in your life?

UNIT 2:

Salient values for life

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work, Positive and creative thinking.

Assignment- 2: Give an example of scenario which explains you are a team player.

UNIT 3:

Human Rights

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

Assignment- 3

Visit Report: Visit to Non-Governmental Organizations (NGO)

UNIT 4: Environment and Ecology

Ecological balance, A Balanced Ecosystem - An Aquarium, Advantages, how to create a balanced ecosystem model, interdependence of all beings – living and non-living. Man, and nature, Environment conservation and enrichment.

Assignment 4: Make a report on following activity

Group Discussion Topics: -

1. Energy and natural resource depletion,
2. Environmental pollution,
3. Global warming,
4. Ozone depletion,
5. Deforestation,
6. Soil degradation.

UNIT 5:

Social values & Ethical values

Social values - Social consciousness and responsibility, Consumer rights and responsibilities
Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Assignment- 5

Write Code of ethics for engineers.

Assignment- 6

Report on guest Lecture: Presentation given by Teacher in the class on the Dr. A P J Kalam's ten points for enlightened Citizenship.

Reference Books:

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003.
2. Chakravarthy, S.K: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.
3. Satchidananda, M.K: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991.
4. Das, M.S. & Gupta, V.K.: Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995.
5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999.
6. Ruhela, S.P.: Human Values and education, Sterling Publications, New Delhi, 1986.

7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975.

8. NCERT, Education in Values, New Delhi, 1992.

9. Swami Budhananda (1983) How to Build Character A Primer: Rmakrishna Mission, New Delhi.

10. A Culture Heritage of India (4 Vols.), Bharatiya Vidya Bhuvan, Bombay, (Selected Chapters only)

11. For Life, For the future: Reserves and Remains – UNESCO Publication.

12. Values, A Vedanta Kesari Presentation, Sri Ramakrishna Math, Chennai, 1996.

13. Swami Vivekananda, Youth and Modern India, Ramakrishna Mission, Chennai.

14. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta.
15. Awakening Indians to India, Chinmayananda Mission, 2003.

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OPTIMIZATION TECHNIQUES

Course Title: OPTIMIZATION TECHNIQUES	**YEAR -IV SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE4.1**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**

Pre requisites: Students should have basic knowledge of engineering mathematics, calculus, matrix algebra, and differential equations. Familiarity with numerical methods, linear programming, and analytical problem-solving techniques used in engineering applications will help in understanding optimization concepts effectively.

Course Objectives:

1. Introduce basic concepts, types, and formulations of optimization problems with classical solution methods.
2. Explore numerical techniques for solving unconstrained optimization problems.
3. Present methods for solving optimization problems with equality and inequality constraints.
4. Teach the theory and solution techniques for unconstrained and constrained geometric programming problems.
5. Introduce integer programming and zero-one programming with solution strategies.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Classify optimization problems and apply classical techniques for single and multivariable optimization.	3	3	3	2	-	3	L2, L3
Solve unconstrained problems using methods like pattern search, Rosenbrock's, simplex, and steepest descent.	3	3	3	3	-	3	L3, L4
Apply penalty methods, feasible direction methods, and solve convex programming problems.	3	3	3	3	-	3	L3, L4
Solve G.P. and C.G.P problems using primal-dual concepts and differential or arithmetic methods.	3	3	3	3	2	3	L3, L4
Solve integer and zero-one programming problems using Gomory's cutting plane and other algorithms.	3	3	3	3	2	3	L3, L4

SYLLABUS

UNIT –I

INTRODUCTION TO OPTIMIZATION: Engineering applications of optimization- statement of an optimization problem- classification of optimization problem- optimization techniques.

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization- multivariable optimization with equality constraints- multivariable optimization with inequality constraints.

UNIT–II

UNCONSTRAINED OPTIMIZATION TECHNIQUES: Pattern search method- Rosenbrock's method of rotating coordinates- Simplex method- Descent methods- Gradient of function- Steepest Descent method.

UNIT–III

CONSTRAINED OPTIMIZATION TECHNIQUES: Characteristics of constrained problem methods of feasible directions - basic approach in the penalty function method- interior penalty function method- convex programming problem- exterior penalty function method.

UNIT–IV

GEOMETRIC PROGRAMMING (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P). Complimentary geometric programming (C.G.P)

UNIT-V

INTEGER PROGRAMMING (I.P): Graphical representation. Gomory's cutting plane method. Algorithm for zero-one programming problem. Integer non-linear programming.

TEXT BOOKS:

1. Optimization Theory and Applications/ S.S.Rao/Wiley Eastern Limited, New Delhi.

REFERENCES:

1. Engineering Optimization / Kalyanmanai Deb/Prentice Hall of India, New Delhi.
2. Optimization Techniques-Theory and applications/C.Mohan&Kusum Deep/New Age International.
3. Operations Research /S.D.Sharma / MacMillan Publishers

ADVANCED MATERIALS

Course Title: ADVANCED MATERIALS	YEAR -IV SEM-I
Teaching Scheme(L:T:P):3:0:0	Credits: 3
Type of Course: Lecture	Course Code: R24MEPE4.2
Continuous Internal Evaluation:30Marks	Semester End Exam:70 Marks
Pre requisites: Students should possess fundamental knowledge of material science, engineering materials, and their mechanical properties. Understanding of crystal structures, composite materials, stress-strain behavior, and manufacturing processes is beneficial for studying advanced materials.	

Course Objectives:

1. Introduce various metallic materials, their applications in extreme environments, and innovative forms like metallic foams.
2. Provide knowledge of natural and synthetic polymers, ceramics, their structures, processing, and industrial applications.
3. Explain the fundamentals, classifications, and reinforcements of composite materials and their engineering relevance.
4. Introduce shape memory alloys and functionally graded materials, focusing on their effects, properties, and applications.
5. Explore the principles, unique properties, and applications of nanomaterials compared to their bulk counterparts.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Identify and evaluate high-performance metals and alloys used in aerospace, cryogenics, and advanced engineering applications.	3	3	2	3	2	3	L1, L5
Classify and compare polymers and ceramics based on properties, processing techniques, and their functional uses.	3	3	2	2	-	3	L2, L4
Distinguish between various composite systems and reinforcement types, and identify their specific industrial applications.	3	3	2	2	-	3	L2, L4
Understand the composition, classification, and application areas of SMAs and FGMs in modern materials engineering.	3	2	2	2	-	3	L2
Analyze nano-scale material behavior, assess their benefits and limitations, and present advanced nano topics through seminars.	3	3	3	3	2	3	L4, L5

SYLLABUS

UNIT –I

ADVANCED METALS & ALLOYS: Metallic materials- super alloys, titanium and Nickel based alloys and intermetallics, Materials for cryogenic application, Materials for space environment, Evaluation of materials for extreme environment, Introduction to metallic foams.

UNIT–II

CERAMICS: Applications - characteristics- classification-Processing of ceramics- Powder preparations- consolidation- hot compaction-drying- sintering-finishing of ceramics, Al_2O_3, silicon nitride Si_3N_4 and Cermets, Areas of applications.

UNIT–III

COMPOSITE MATERIALS: Introduction, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber- reinforced composites and nature-made composites, and applications.

REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres.

UNIT–IV

SHAPE MEMORY ALLOYS: Introduction-shape memory effect classification of shape memory alloys-composition-properties and applications of shape memory alloys.

FUNCTIONALLY GRADED MATERIALS: Types of functionally graded materials-classification different systems-preparation-properties applications of functionally graded materials.

UNIT-V

NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages applications in comparison with bulk materials (nano – structure, wires, tubes, composites). state of art nano advanced- topic delivered by student.

TEXT BOOKS:

1. Nano material /A.K. Bandyopadyay/New age Publishers
2. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
3. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press

REFERENCES:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van Nostrand Rainfold,NY 1969
3. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience, New York, 1980.
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /AutarK.Kaw /CRC Press

SUPPLY CHAIN MANAGEMENT

Course Title: SUPPLY CHAIN MANAGEMENT	**YEAR -IV SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE4.3**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Students should have basic understanding of production systems, manufacturing operations, and industrial management concepts. Familiarity with inventory management, logistics, and operations management principles will support learning supply chain strategies and decision-making.	

Course Objectives:

1. Identify the strategies and models of Supply Chain Management
2. Describe the criteria for Supply Chain Management decisions
3. Understand the Key issues in supply chain management
4. Understand the uncertainties in supply chain management.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Explain the strategies and models of Supply Chain Management	3	2	2	2	-	2	L2
Identify the prospective supplier with Vendor rating	3	2	3	2	-	2	L3
Apply the inventory management concepts for deterministic inventory models to optimize the total inventory control cost	3	3	3	3	-	2	L3
Apply the inventory management concepts to uncertainty cases.	3	3	3	3	-	2	L3
Determine the criteria for decision making in Supply Chain Management	3	3	3	3	2	2	L3

SYLLABUS

UNIT –I

Introduction to Supply Chain Management (SCM): Concept of Logistics Management, Concept of SCM, Core competency, Value chain, Elements of supply chain efficiency, Flow in supply chains, Key issues in supply chain management. Application: Automobile plants, Machinery units, Machine tools industry, Electronic goods industry

UNIT–II

Sourcing and Procurement: Outsourcing benefit, Importance of suppliers, Evaluating a potential supplier, Vendor rating, Competitive bidding and Negotiation, E-procurement Application: Online ordering system, Purchase of capital goods in large scale industries, Selection of supplies in manufacturing plants.

UNIT–III

Introduction to Inventory Management: Selective Control Techniques, ABC analysis – procedure, VED analysis, Inventory control costs. Deterministic Inventory Models with out shortages, Quantity Discounts -Make-or-buy decisions. -Exercises Application: Stores management in manufacturing plants

UNIT–IV

Independent Demand Systems (Probabilistic Models): Q- system, P- system, Reorder level, buffer stock, and service level, -Exercises, Bullwhip effect, Information system for Supply Chain Management Application: Inventory management with uncertainties in manufacturing plants

UNIT-V

Decision making and application: Decision making in SC – Applications of SCM – warehouse management system – product data management – E –Commerce – Reverse logistics – Cases in Automobile industry – Machine tools industry, Electronic goods industry Application: Ware house management in manufacturing plants, Automobile industry –Machine tools industry, Electronic goods industry

TEXT BOOKS:

1. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi.

REFERENCES:

1. Chopra, S., and Meindl, P., Supply Chain Management: Strategy, Planning and Operations.Second Edition, Pearson Education (Singapore) Pte. Ltd.
2. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw Hill Edition

REFRIGERATION & AIR CONDITIONING

Course Title: REFRIGERATION & AIR CONDITIONING	**YEAR -IV SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE4.4**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Students should have knowledge of thermodynamics, heat transfer, and fluid mechanics. Understanding energy conversion systems, properties of gases, and basic mechanical engineering concepts will help in learning refrigeration and air conditioning systems.	

Course Objectives:

1. To illustrate the operating cycles and different systems of refrigeration
2. To analyze cooling capacity and coefficient of performance of vapour compression refrigeration systems and understand the fundamentals of cryogenics
3. To calculate coefficient of performance by conducting test on vapour absorption and steam jet refrigeration system and understand the properties refrigerants.
4. To calculate cooling load for air conditioning systems and identify the requirements of comfort air conditioning.
5. To describe different component of refrigeration and air conditioning systems

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Illustrate the operating cycles and different systems of refrigeration.	3	2	2	2	-	3	L2
Analyze cooling capacity and coefficient of performance of vapour compression refrigeration systems and understand the fundamentals of cryogenics	3	3	3	3	-	3	L4
Calculate coefficient of performance by conducting test on vapour absorption and steam jet refrigeration systems and understand the properties of refrigerants	3	3	3	3	-	3	L3
Solve cooling load for air conditioning systems and identify the requirements of comfort air conditioning.	3	3	3	3	-	3	L3, L4
Demonstrate different components of refrigeration and air conditioning systems.	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I

INTRODUCTION TO REFRIGERATION: Necessity and applications – unit of refrigeration and C.O.P. – Mechanical refrigeration – types of ideal cycles of refrigeration. air refrigeration: Bell Coleman cycle - open and dense air systems – refrigeration systems used in air crafts and problems.

UNIT–II

VAPOUR COMPRESSION REFRIGERATION SYSTEM &COMPONENTS: Working principle and essential components of the plant – simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

INTRODUCTION TO CRYOGENICS: Joule-Thomson expansion, refrigerant mixtures, multi stage vapour compression refrigeration.

UNIT–III

REFRIGERANTS– Desirable properties – classification - refrigerants –green refrigerants-nomenclature – ozone depletion – global warming.

VAPOR ABSORPTION SYSTEM: Calculation of maximum COP – description and working of NH3 – water system and Li Br –water (Two shell & four shell) System, principle of operation three fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM: Working Principle and basic components, principle and operation of thermoelectric refrigerator and vortex tube.

UNIT–IV

INTRODUCTION TO AIR CONDITIONING: Psychometric properties & processes – characterization of sensible and latent heat loads — need for ventilation, consideration of infiltration – load concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature. Requirements of human comfort and concept of effective temperature- comfort chart comfort air conditioning – requirements of industrial air conditioning, air conditioning load calculations.

UNIT-V

AIR CONDITIONING SYSTEMS: Classification of equipments, cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. heat pump – heat sources – different heat pump circuits.

Note: Refrigeration and Psychrometric tables and charts are allowed.

TEXT BOOKS:

1. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar / Dhanpatrai
2. Refrigeration and Air Conditioning / CP Arora / TMH.

REFERENCES:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age.
2. Principles of Refrigeration /Dossat / Pearson Education.
3. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / TMH

SMART MANUFACTURING

Course Title: SMART MANUFACTURING	**YEAR -IV SEM-I**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE4.5**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Students should have basic understanding of manufacturing processes, industrial automation, and control systems. Familiarity with sensors, computer applications, IoT concepts, and emerging Industry 4.0 technologies will support the study of smart manufacturing systems.	

Course Objectives:

1. To apply knowledge of smart manufacturing systems' components in the context of Industry 4.0
2. To understand the concepts of smart machines and smart sensors.
3. To understand and apply the concepts of IoT connectivity to Industry 4.0.
4. To understand the concepts of Digital Twin and apply Machine Learning and Artificial Intelligence concepts in Manufacturing.
5. To understand the concepts of Metaverse platform

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Learn about smart manufacturing systems' components and can handle it more effectively in context of Industry 4.0	3	2	2	2	2	3	L1, L2
Learn about the smart machines and smart sensors	3	2	2	2	2	3	L1, L2
Apply IoT to Industry 4.0 and they are able to make a system tailor-made as per requirement of the industry	3	3	3	3	2	3	L3, L4
Learn about concepts of Digital Twin and able to apply Machine Learning and Artificial Intelligence concepts in Manufacturing	3	3	3	3	2	3	L3, L4
Learn the concepts of AR/VR and Metaverse platform	3	2	2	2	2	3	L1, L2

SYLLABUS

UNIT –I

Concepts of Smart Manufacturing: Definition and key characteristics of smart manufacturing, Corporate adaptation processes, manufacturing challenges, challenges vs technologies, Stages in smart manufacturing. Minimizing Six big losses in manufacturing with Industry 4.0, and their benefits.

UNIT–II

Smart Machines and Smart Sensors: Concept and Functions of a Smart, Machine Salient features and Critical Subsystems of a Smart Machine, Smart sensors; smart sensors ecosystem, need, benefits and applications of sensors in industry, Introduction to IoT, IIoT, and Cyber physical systems, Sensing for Manufacturing Process in IIoT, Block Diagram of an IoT Sensing Device, Sensors in IIoT Applications, Smart Machine Interfaces,

UNIT–III

IoT connectivity for Industry 4.0: Industrial communication requirement and its infrastructure, an overview of different types of networks, mesh network in industrial IoT, IoT protocols and the internet, TCP/IP (transmission control protocol/internet protocol) model, IoT connectivity standards: common protocols, application layer protocols, internet/network layer protocols, physical layer IoT protocols, choosing the right IoT connectivity protocol.

UNIT–IV

Digital Twin: Introduction, applications of digital twins, impact zones of digital twins in manufacturing (factories/plants and OEMs), advantages of digital twins, basic steps of digital twin technology

Machine Learning (ML) and Artificial Intelligence (AI) in Manufacturing: Introduction, benefits and applications of ML in industries, common approaches of ML; supervised and unsupervised, semi-supervised and reinforced ML.

UNIT-V

Metaverse – Basic concepts, AR/VR, Social Metaverse, Industrial Metaverse, How Web 3.0 is changing the Internet, Asset Classes Inside the Metaverse, Land, Coins, Characters/ Avatars, Skins, Utility, Industries Disrupted by the Metaverse, Smart wearables,

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.
4. Aurélien Géron, Hands on Machine Learning with Scikit-Learn and TensorFlow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media, 2017.
5. Artificial Intelligence and Machine Learning, Principles and applications by Vinod Chandra S.S., Anand Hareendran S., PHI

REFERENCES:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2012.
3. M.C. Trivedi, A Classical Approach to Artifical Intelligence, Khanna Publishing House,New Delhi, 2018.
4. S. Kaushik, Artificial Intelligence, Cengage Learning India, 2011.

POWER PLANT ENGINEERING

Course Title: POWER PLANT ENGINEERING	YEAR -IV SEM-II
Teaching Scheme(L:T:P):3:0:0	Credits: 3
Type of Course: Lecture	Course Code: R24MEPE5.1
Continuous Internal Evaluation:30Marks	Semester End Exam:70 Marks
Pre requisites: Students should have fundamental knowledge of thermodynamics, heat transfer, and fluid mechanics. Understanding of energy conversion systems, internal combustion engines, and basic mechanical engineering concepts is helpful. Familiarity with power generation processes and engineering mathematics will support learning different power plant systems.	

Course Objectives:

1. To understand the sources of energy and concepts of steam power plant.
2. To design of components of steam, gas and diesel power plants.
3. To explain the principles of hydro power plant and nuclear power station.
4. To apply the concepts of nuclear reactors and understand the operations of different power plants.
5. To understand the principles and concepts relevant to power plant instrumentation, control, economics and environmental considerations.

Course Outcomes	PO1	PO2	PO3	PO4	P011	PS01	BT LEVEL
Illustrate the functions of different components of steam power plant	3	2	2	2	-	3	L2
Describe basic working principles, performance characteristics and components of gas turbine and diesel power plants	3	2	2	2	-	3	L2
Illustrate basic working principles of hydroelectric power plants and analyze the importance of hydrological cycles, measurements and drainage characteristics	3	3	3	3	-	3	L2, L4
Learn about the principal components and types of nuclear reactors	3	2	2	2	2	3	L1, L2
Analyze the working of power plant instrumentation and estimate the economics of power plants	3	3	3	3	2	3	L4, L5

SYLLABUS

UNIT –I

Introduction to the sources of energy – resources and development of power in India.

STEAM POWER PLANT: Plant layout, working of different circuits, fuel handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components,

UNIT–II

STEAM POWER PLANT: Combustion needs and draught system, cyclone furnace, design and Construction, dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment. **INTERNAL COMBUSTION AND GAS TURBINE POWER PLANTS:** DIESEL POWER PLANT: Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging. GAS TURBINE PLANT: Introduction – classification - construction – layout with auxiliaries, combined cycle power plants and comparison.

UNIT–III

HYDRO ELECTRIC POWER PLANT: Water power – hydrological cycle / flow measurement – drainage area characteristics – hydrographs – storage and pondage – classification of dams and spillways. HYDRO PROJECTS AND PLANT: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants. **NUCLEAR POWER STATION:** Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation.

UNIT–IV

TYPES OF NUCLEAR REACTORS: Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro-electric and gas turbine stations, co-ordination of hydro electric and nuclear power stations, co-ordination of different types of power plants.

UNIT-V

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements, smart grids, power plant control room.

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS: Capita cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment –pollutants and pollution standards – methods of pollution control.

TEXT BOOKS:

1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai ; Co. 2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub

REFERENCES:

1. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
2. Power station Engineering – ElWakil / McGraw-Hill.
3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers

4.

INDUSTRIAL ROBOTICS

Course Title: INDUSTRIAL ROBOTICS	**YEAR -IV SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE5.2**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Students should possess basic knowledge of manufacturing processes, automation, and control systems. Understanding of engineering mechanics, electrical systems, sensors, and programming fundamentals is useful. Familiarity with kinematics and machine operations will help in learning robotics concepts effectively.	

Course Objectives:

1. Discuss various applications and components of industrial robot systems
2. Learn about the types of actuators used in robotics
3. Calculate the forward kinematics and inverse kinematics.
4. Learn about programming principles and languages for a robot control system
5. Discuss the applications of image processing and machine vision in robotics.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Discuss various applications and components of industrial robot systems	3	2	2	2	2	3	L2
Learn about the types of actuators used in robotics	3	2	2	2	-	3	L1, L2
Calculate the forward kinematics and inverse kinematics.	3	3	3	3	-	3	L3
Learn about programming principles and languages for a robot control system	3	2	3	2	2	3	L1, L2, L3
Discuss the applications of image processing and machine vision in robotics.	3	3	3	3	2	3	L2, L4

SYLLABUS

UNIT –I

INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics – An overview of Robotics –present and future applications – classification by coordinate system and control system.

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Robot anatomy, work volume, components, number of degrees of freedom - robot drive systems, function line diagram representation of robot arms, common types of arms -– requirements and challenges of end effectors, determination of the end effectors.

UNIT–II

ROBOT ACTUATORS AND FEED BACK COMPONENTS: Actuators: Pneumatic, Hydraulic actuators, electric& stepper motors. Comparison of Electric, Hydraulic and Pneumatic types of actuation devices. Feedback components: position sensors–potentiometers, resolvers, encoders–Velocity sensors.

UNIT–III

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics–problems.

UNIT–IV

GENERAL CONSIDERATIONS IN PATH DESCRIPTION AND GENERATION: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion–Robot programming, languages and software packages-description of paths with a robot programming language.

UNIT-V

IMAGE PROCESSING AND MACHINE VISION: Introduction to Machine Vision, Sensing and Digitizing function in Machine Vision, Training and Vision System, Robotic Applications.

TEXT BOOKS:

1. Industrial Robotics/Groover MP/Pearson Edu.
2. Robotics and Control /Mittal R K &Nagrathi J /TMH.
3.

REFERENCES:

1. Robotics/Fu KS/ McGraw Hill.
2. Robotic Engineering /Richard D. Klafter, Prentice Hall
3. Robot Analysis and Control/ H. Asada and J.J.E. Slotine/BSP Books Pvt.Ltd.
4. Introduction to Robotics/John J Craig/PearsonEdu.

PRODUCTION PLANNING AND CONTROL

Course Title: PRODUCTION PLANNING AND CONTROL	**YEAR -IV SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE5.3**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**
Pre requisites: Students should have basic understanding of manufacturing systems, industrial engineering, and operations management. Knowledge of production processes, inventory concepts, and engineering economics is beneficial. Familiarity with planning and scheduling methods will support learning production control techniques.	

Course Objectives:

1. To learn the fundamentals of production planning and control systems.
2. To understand forecasting techniques and their role in production decisions.
3. To learn inventory management methods and production control systems.
4. To know the principles of routing, scheduling, and production planning.
5. To understand dispatching procedures and computer applications in production control.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Summarize the different types of production systems and the internal organization of production planning and control.	3	2	2	2	-	3	L2
Estimate forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.	3	3	3	3	-	3	L3, L5
Outline the importance and function of inventory and apply for its control and management.	3	3	3	2	-	3	L2, L3
Apply routing procedures and differentiate schedule and loading and interpret scheduling policies and aggregate planning.	3	3	3	3	-	3	L3, L4
Illustrate dispatching procedure and applications of computers in production planning and control	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I Introduction:

Introduction**:** Definition – objectives and functions of production planning and control – elements of production control – organization of production planning and control department – internal organization of department. Types of production:

UNIT–II Forecasting

Forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques – qualitative methods and quantitative methods. Importance of forecasting.

UNIT–III Inventory management

Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems Introduction to MRP I, MRP II, LOB (Line of Balance), JIT and KANBAN system. ERP

UNIT–IV Routing

Routing –definition – routing procedure –route sheets – factors affecting routing procedure, schedule definition – difference with loading. Scheduling policies – techniques, standard scheduling methods. Line Balancing, aggregate planning, chase planning, expediting, controlling aspects Bill of material

UNIT-V Dispatching

Dispatching – activities of dispatcher – dispatching procedure –follow up – definition – reason for existence of functions – types of follow up, applications of computer in production planning and control. Types of follow up

TEXT BOOKS:

1. Elements of Production Planning and Control / Samuel Eilon/Universal Book Corp.
2. Manufacturing, Planning and Control/Partik Jonsson Stig- Arne Mattsson/TataMcGrawHill

REFERENCES:

1. Inventory Control Theory and Practice / Martin K. Starr and David W.Miller/Prentice-Hall
2. Production Planning andControl/Mukhopadyay/PHI.
3. Production Control A Quantitative Approach / John E.Biegel/Prentice-Hall
4. Production Control / Franklin G Moore & Ronald Jablonski/Mc-GrawHill
5. Production and Operations Management/Shailendra Kale/McGraw-Hill.
6. Production and Operations Management/Ajay K Garg/McGraw-Hill

Online Learning Resources:

1. https://nptel.ac.in/courses/110/107/110107141/
2. https://pdfcoffee.com/qdownload/production-planning-and-control-by-jayakumar-pdf-free.html

DESIGN FOR MANUFACTURING

Course Title: DESIGN FOR MANUFACTURING	**YEAR -IV SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE5.4**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**

Pre requisites: Students should have fundamental knowledge of manufacturing processes, machine tools, and engineering drawing. Understanding of material properties, machining operations, and production methods is important. Familiarity with product design concepts will help in learning design for manufacturing principles.

Course Objectives:

1. To understand the basic concepts of design for manual assembly
2. To interpret basic design procedure of machining processes
3. To understand design considerations metal casting, extrusion and sheet metal work
4. To interpret the design considerations of various metal joining process.
5. To interpret the basic design concepts involved in the assembly automation

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Understand the basic concepts of design for manual assembly	3	2	2	2	-	3	L2
Identify basic design procedure of various machining processes.	3	2	3	2	-	3	L1, L2
Illustrate the design considerations metal casting, extrusion and sheet metal work	3	2	3	2	-	3	L2, L3
Interpret the design considerations of various metal joining process.	3	3	3	2	-	3	L2, L3
Understand the basic design concepts involved in the assembly automation	3	2	3	2	2	3	L2, L3

SYLLABUS

UNIT –I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design? Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, weight on Handling Time, Effects of Combinations of Factors and application of the DFA Methodology.

UNIT–II

Machining processes: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT–III

Metal casting: Appraisal of various casting processes, selection of casting process, general design considerations for casting-casting tolerance-use of solidification, simulation in casting design product design rules for sand casting. Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, and deep drawing-Keeler Goodman forging line diagram – component design for blanking

UNIT–IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT-V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, and single station assembly lines. Design for Additive Manufacturing: Design considerations, allowances

TEXT BOOKS:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla

REFERENCES:

ASM Hand book Vol.20

OPERATIONS RESEARCH

Course Title: Operations Research	**YEAR -IV SEM-II**
Teaching Scheme(L:T:P):3:0:0	**Credits: 3**
Type of Course: Lecture	**Course Code: R24MEPE5.5**
Continuous Internal Evaluation:30Marks	**Semester End Exam:70 Marks**

Pre requisites: Students should possess basic knowledge of Engineering Mathematics, particularly matrices, calculus, probability, and statistics. Understanding of basic optimization techniques, algebraic equations, and graph plotting methods is essential for solving operational research problems. Familiarity with concepts of production systems, decision making, and analytical thinking will help students understand linear programming, transportation, inventory, queuing, game theory, and simulation models effectively. Basic computer knowledge and problem-solving skills are also desirable for applying mathematical models to engineering and industrial applications.

Course Objectives:
1. To Analyze Linear Programming models
2. To Interpret Transportation and sequencing problems
3. To Solve replacement problems and analyze queuing models
4. To Analyze game theory and inventory problems
5. To Interpret dynamic programming and simulation.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**P011**	**PS01**	**BT LEVEL**
Analyze Linear Programming models	3	3	2	2	1	3	L4
Interpret Transportation and sequencing problems	3	3	2	2	1	3	L2
Solve replacement problems and analyze queuing models	3	3	2	3	1	3	L3,L4
Analyze game theory and inventory problems	3	3	2	3	1	3	L4
Interpret dynamic programming and simulation.	3	3	2	3	1	3	L2

SYLLABUS

UNIT –I

Introduction: Development – definition– characteristics and phases – types of operation research models – applications.

ALLOCATION: Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.

UNIT–II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- travelling salesman problem. SEQUENCING – Introduction – flow –shop sequencing – n jobs through two machines – n jobs through three machines – job shop sequencing – two jobs through 'm' machines.

UNIT–III

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

UNIT–IV

WAITING LINES: Introduction – single channel – poison arrivals – exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

INVENTORY: Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

UNIT-V

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem

SIMULATION: Definition – types of simulation models – phases of simulation– applications of simulation – inventory and queuing problems – advantages and disadvantages – simulation languages

TEXT BOOKS:

1. Operations Research-An Introduction/Hamdy A Taha/Pearson publishers
2. Operations Research –Theory & publications / S.D.Sharma-Kedarnath/McMillan publishers India Ltd

REFERENCES:

1.Introduction to O.R/Hiller & Libermann/TMH
2. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi /Pearson Education.
3. Operations Research: Methods & Problems / Maurice Saseini, Arhur Yaspan & Lawrence Friedman/Wiley
4. Operations Research / R.Pannerselvam/ PHI Publications.
5. Operations Research / Wagner/ PHI Publications.
6. Operation Research /J.K.Sharma/MacMilan Publ.
7. Operations Research/ Pai/ Oxford Publications
8. Operations Research/S Kalavathy / Vikas Publishers
9. Operations Research / DS Cheema/University Science Press
10. Operations Research / Ravindran, Philips, Solberg / Wiley publishers

INTERSHIP & PROJECT WORK

Course Title: Internship & Project Phase-II	**YEAR -IV SEM-II**
Teaching Scheme(L:T:P):0:0:24	**Credits:12**
Type of Course: PROJECT	**Course Code: R24PR01**

PRINCIPLES OF ROBOTICS

Course Title: PRINCIPLES OF ROBOTICS	
Teaching Scheme(L:T:P): 3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code: R24MEOE01**
Continuous Internal Evaluation: 30Marks	**Semester End Exam:70Marks**
Pre requisites: Basic knowledge of engineering mechanics, kinematics of machines, machine design, electrical drives, hydraulic and pneumatic systems, control systems, engineering mathematics, manufacturing processes, programming fundamentals, and industrial safety is required to understand Robotics and Automation.	

Course Objectives:
1. Understand and discuss the fundamental elementary concepts of Robotics.
2. Provide insight into different types of robots.
3. Explain intelligent module for robotic motion control.
4. Educate on various path planning techniques.
5. Illustrate the working of innovative robotic devices.

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT**
Understand the significance, social impact and future prospects of robotics and automation in various engineering applications.	2	1	1	1	L2
Identify and describe the components and anatomy of robotic system.	3	1	1	3	L1, L2
Know about various path planning techniques and analyze different motions of robotics system	3	3	2	3	L4
Use the suitable drives and end-effectors for a given robotics application.	3	2	3	3	L3
Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios.	3	2	3	3	L3, L4

SYLLABUS

UNIT–I

Introduction To Robotics: Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots.

UNIT–II

Robot Anatomy And Motion Analysis: Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.

UNIT –III

Robot Drives And End Effectors: Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.

UNIT–IV

Path Planning: Definition-Joint space technique, Use of P-degree polynomial-Cubic, polynomial-Cartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning.

UNIT–V

Robotics Applications: Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots.

TEXTBOOK:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).
3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987. https://www.robots.com/applications.

GREEN MANUFACTURING

Course Title: GREEN MANUFACTURING	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code: R24MEOE02**
Continuous Internal Evaluation: 30Marks	**Semester End Exam:70Marks**
Pre requisites:. Students are expected to possess basic knowledge of **manufacturing processes, environmental science, engineering materials, energy resources, waste management, and engineering design principles**. These prerequisites help students understand the concepts of green manufacturing, recycling techniques, eco-design, pollution prevention, emission-less manufacturing, renewable energy utilization, and sustainable economic practices.	

Course Objectives:

The students will acquire the knowledge:
1. To understand concepts of green manufacturing
2. To illustrate various recycling techniques.
3. To apply concepts of green design methods.
4. To understand the concepts of eco design and emission less manufacturing.
5. To apply concepts of the sustainable economic environment.

COURSEOUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT LEVEL**
Understand concepts of green manufacturing.	2	1	1	-	L2
Illustrate various recycling techniques.	2	1	1	-	L2
Apply concepts of green design methods.	2	2	3	2	L3
Understand the concepts of eco design and emission less manufacturing.	2	1	2	1	L2
Apply concepts of the sustainable economic environment	1	2	2	-	L3

SYLLABUS

UNIT–I

INTRODCTION: Environmental effects and environmental damage – In efficient energy use – Concepts of Green Manufacturing. Waste – Collection, sorting, cleaning –Characterization of waste streams**.**

UNIT–II

Recycling Techniques: Recycling rate, material recovery facilities – Integrating recycling with landfills – Processing equipments, Processing facilities for recyclable materials

UNIT –III

Green design methods: Mass balance analysis – Green indicate – Design for disassembly design for recycle – Risk analysis – Material selection

UNIT–IV

Eco design – Industrial Ecology – Pollution prevention – Reduction of toxic emissions and Emission less manufacturing

UNIT–V

Sustainable economic environment: Solar energy devices – wind energy resources – Full cost accounting methodology – Selection of natural friendly materials for green manufacturing.

TEXT BOOKS:

1. Dornfield David, Green Manufacturing, Springer, 2012
2. Davim.J.Pauls, Green Manufacturing Processes and Systems, Springer, 2013

REFERENCES:

1. Cairncrss and Francis – Costing the earth – Harvard Business School Press – 2009
2. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.

ELECTRIC AND HYBRID VEHICLES

Course Title: ELECTRIC AND HYBRID VEHICLES	
Teaching Scheme(L:T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	**Course Code: R24MEOE03**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Basic knowledge of automobile engineering, electrical engineering, electrical machines, power electronics, IC engines, energy storage systems, control systems, engineering mathematics, and communication protocols is required to understand hybrid and electric vehicle systems.	

Course Objectives:
To present a comprehensive overview of Electric and Hybrid Electric Vehicles.

COURSEOUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT**
Illustrate a suitable drive scheme for developing an electric hybrid vehicle depending on resources	3	2	2	2	L3
Design and develop basic schemes of electric vehicles and hybrid electric vehicles.	3	2	3	3	L6
Select proper energy storage systems for vehicle applications	3	3	2	1	L5
Identify various communication protocols and technologies used in vehicle networks.	2	1	1	1	L1
Identify in-vehicle communication networks and compare different energy management strategies used in hybrid and electric vehicles.	2	2	1	1	L4

SYLLABUS

UNIT–I

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT–II

Hybrid Electrical Drive-trains: Basic concept of hybrid traction , introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT –III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT–IV

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology

UNIT–V

Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

TEXTBOOK:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

REFERENCES:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric
3. and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

INDUSTRIAL SAFETY

Course Title: INDUSTRIAL SAFETY	
Teaching Scheme(L:T:P): 3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code: R24MEOE04**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Basic knowledge of mechanical engineering, manufacturing processes, electrical engineering, thermal engineering, hydraulic and pneumatic systems, material science, industrial safety, machine components, and engineering economics is required to understand Industrial Safety and Maintenance Engineering.	

Course Objectives:

1. To provide information regarding different elements of industrial water pollution and Methods of treatment.
2. To expose to the various industrial applications, maintenance, preventive measures taken against wear and tear.

COURSE OUTCOMES	PO1	PO2	PO3	PS01	BT
Know how to take safety measures in executing works	2	1	1	1	L2
Identify the need for maintenance (or) replacement of equipment	3	3	2	3	L3
Illustrate the need for periodic and preventive maintenance	2	2	1	2	L2
Apply fault-tracing methods and decision-tree techniques to diagnose faults in mechanical, electrical, hydraulic, pneumatic, automotive, and thermal equipment.	3	3	2	3	L3
Prepare periodic and preventive maintenance schedules, repair cycles, and overhauling procedures for mechanical and electrical equipment.	3	2	3	3	L6

SYLLABUS

UNIT–I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT–II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT –III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication Side feed lubrication, Ring lubrication

Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT–IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like,

i. Any one machine tool,
ii. Pump
iii. Air compressor
iv. Internal combustion engine,
v. Boiler
vi. Electrical motors,
vii. Types of faults in machine tools and their general causes.

UNIT–V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:

i. Machine tools
ii. Pumps,
iii. Air compressors,
iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance

REFERENCES:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall Lon

INTRODUCTION TO CAD

Course Title: INTRODUCTION TO CAD	
Teaching Scheme(L:T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	**Course Code: R24MEOE05**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Basic knowledge of engineering drawing, engineering graphics, computer operation, coordinate geometry, machine drawing, manufacturing processes, and design fundamentals is required to understand Computer Aided Design..	

Course Objectives:

1. To develop skills in 2D drafting and 3D modeling.
2. To understand modeling techniques and visualization tools.
3. To expose students to industry-relevant CAD software tools.
4. To introduce basic concepts of CAD and its applications in engineering.

COURSE OUTCOMES	PO1	PO2	PO3	PS01	BT LEVEL
Understand fundamentals and applications of CAD systems.	2	1	1	2	L2
Apply 2D drafting techniques using CAD tools.	3	2	2	3	L3
Develop 3D models using standard modeling techniques.	3	2	3	3	L3
Interpret and create engineering drawings digitally.	3	2	3	3	L3
Understand advanced CAD applications in industry.	2	1	2	3	L2

SYLLABUS

UNIT–I

Introduction to CAD: Definition and scope of CAD, Evolution of CAD systems, Hardware components: Input, Output devices, Graphics display, CAD software overview, Applications of CAD in various engineering fields, Benefits and limitations of CAD

UNIT–II

Fundamentals of Computer Graphics: Coordinate systems (Cartesian, Polar), Graphics primitives (points, lines, arcs, circles), Transformations**:** Translation, Rotation, Scaling, Windowing and clipping, Introduction to 2D drafting environment, Layers, line types, and object properties

UNIT –III

2D Drafting and Editing: Basic drawing commands, Editing tools: Trim, Extend, Offset, Mirror, Fillet, Chamfer, Dimensioning techniques and standards, Text and annotation, Hatching and sectioning, Practice of engineering drawings using CAD software

UNIT–IV

3D Modeling Concepts: Introduction to 3D modeling, Types of models: Wireframe, Surface, Solid ,3D coordinate system, Solid modeling techniques: Extrude, Revolve, Sweep, Loft, Boolean operations (Union, Subtract, Intersect), Visualization and rendering basics

UNIT–V

Advanced CAD Applications: Assembly modeling concepts, Introduction to parametric modeling, Basics of simulation and analysis (overview), CAD data exchange formats (IGES, STEP, STL), Introduction to CAD/CAM integration, Industry applications and case studies

Textbooks:

1. Mastering CAD/CAM / IbrhimZeid / McGraw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition

Reference Books:

3. CAD/CAM /Groover M.P./ Pearson education
4. CAD/CAM Concepts and Applications/ Alavala/ PHI
5. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
6. Principles of Computer Aided Design and Manufacturing/ FaridAmirouche/ Pearson
7. Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson

WASTE TO ENERGY CONVERSION

Course Title: WASTE TO ENERGY CONVERSION	
Teaching Scheme(L:T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	**Course Code: R24MEOE06**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Basic knowledge of environmental science, waste management, renewable energy sources, thermodynamics, fuels and combustion, engineering chemistry, microbiology, biomass conversion, power plant engineering, and material science is required to understand Energy Production from Wastes..	

Course Objectives:

1. To introduce students to the different types of waste and their characterization.
2. To teach students the various methods of converting waste to energy.
3. To develop students' understanding of the principles behind the conversion processes.
4. To equip students with the knowledge and skills to design and implement waste-to-energy projects.

COURSE OUTCOMES	PO1	PO2	PO3	PS01	BT
Student will be able to characterize different types of waste and understand the principles behind waste-to-energy conversion processes.	3	2	1	-	L2
Analyze the suitability of different waste-to-energy conversion methods for specific waste types.	3	3	2	1	L4
Design and implement waste-to-energy projects	3	3	3	2	L6
Apply practical experience in waste-to-energy conversion techniques.	3	2	2	1	L3
Analyze solid waste-to-energy techniques such as densification, power plant efficiency improvement, and energy production from waste plastics.	3	3	2	1	L4

SYLLABUS

UNIT–I

Wastes: Introduction and characterization of wastes, definition of waste, types of waste, characteristics of waste, waste disposal methods.

UNIT–II

Energy Production from Wastes – I: Energy production through incineration, gasification, pyrolysis and syngas utilization. Incineration: principle, advantages, and disadvantages; Gasification: principle, advantages, and disadvantages; Pyrolysis: principle, advantages, and disadvantages; Syngas utilization: principle, advantages, and disadvantages.

UNIT –III

Energy Production from Wastes – II: Energy production through anaerobic digestion, fermentation, transesterification and introduction to microbial fuel cells. Anaerobic digestion: principle, advantages, and disadvantages; Fermentation: principle, advantages, and disadvantages; Transesterification: principle, advantages, and disadvantages; Introduction to microbial fuel cells: principle, advantages, and disadvantages.

UNIT–IV

Energy Production from Algae: Cultivation of algal biomass from wastewater and energy production from algae. Algae cultivation: principle, advantages, and disadvantages; Energy production from algae: principle, advantages, and disadvantages; Applications of algae in waste management.

UNIT–V

Energy Production from Solid Wastes: Densification of solids, efficiency improvement of power plant and energy production from waste plastics. Densification of solids: principle, advantages, and disadvantages; Efficiency improvement of power plants: principle, advantages, and disadvantages; Energy production from waste plastics: principle, advantages, and disadvantages; Applications of waste plastics in energy generation

REFERENCES:

1. Rogoff, M. J. and Screve, F., “Waste-to-Energy: Technologies and Project Implementation”, Elsevier Store, 2011.
2. Young G. C., “Municipal Solid Waste to Energy Conversion processes”, John Wiley and Sons, 2010.
3. Harker, J. H. and Backhusrt, J. R., “Fuel and Energy”, Academic Press Inc, 1981.
4. EL-Halwagi, M. M., “Biogas Technology – Transfer and Diffusion”, Elsevier Applied Science, 1986.
5. Hall, D.O. and Overeed, R.P.,” Biomass – Renewable Energy”, John Willy and Sons.
6. Mondal, P. and Dalai, A. K. eds., 2017. Sustainable Utilization of Natural Resources. CRC Press.

HYDROGEN AND FUEL CELL TECHNOLOGY

Course Title: HYDROGEN AND FUEL CELL TECHNOLOGY	
Teaching Scheme(L:T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	**Course Code: R24MEOE07**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Basic knowledge of engineering chemistry, thermodynamics, electrochemistry, renewable energy sources, fuels and combustion, heat and mass transfer, fluid mechanics, material science, and environmental science is required to understand Hydrogen Energy Systems and Fuel Cells.	

Course Objectives:

1. To gain insight about hydrogen energy, fuel cells, their working principle, types of fuel cells and performance analysis.

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT**
Gain knowledge on fuel cell working principle, types of fuel cell, voltage loss and its reason	3	1	1	1	L2
Interpret the role of fluid dynamics, reaction kinetics and mass transfer principles in fuel cell operation.	3	2	1	1	L2
Illustrate the stacking of fuel cell and fuel processing for fuel cell.	3	2	2	2	L2
Analyze fuel cell electrode kinetics, charge transfer reactions, exchange current density, Butler–Volmer equation, electrocatalysis, and Tafel equation for fuel cell performance evaluation.	3	3	1	1	L4
Analyze charge transport, mass transport, electrolyte classes, voltage losses, and compare different types of fuel cells based on construction, operation, and applications.	3	3	2	2	L4

SYLLABUS

UNIT–I

Introduction to hydrogen energy systems: Current scenario of hydrogen production, general introduction to infrastructure requirement for hydrogen production, dispensing and utilization. **Hydrogen production pathways:** Thermal: Steam reformation, Thermo chemical water splitting, Gasification, Pyrolysis and Partial oxidation methods. Electrochemical: Electrolysis, Photo-electro chemical. Biological: Anaerobic Digestion, Fermentative Micro-organisms

UNIT–II

Hydrogen Storage: General storage methods, compressed storage, Zeolites, Metal hydride storage, chemical hydride storage and cryogenic storage. Hydrogen Utilization: Overview of hydrogen utilization, I.C. Engines, gas turbines, hydrogen burners, power plant, refineries, domestic, marine applications, fuel cell.

UNIT –III

Introduction to Fuel Cell: A simple fuel cell, fuel cell advantages, fuel cell disadvantages, fuel cell types basic fuel cell operation, fuel cell performance characterization and modeling, fuel cell technology, fuel cells and the environment. Fuel Cell Thermodynamics: Thermodynamics review, Heat potential of a fuel: enthalpy of reaction, Work potential of a fuel: Gibbs Free Energy, Predicting eversible voltage of a fuel cell under non-Standard state conditions, fuel cell efficiency, Thermal and Mass balances in fuel cells, Thermodynamics of reversible fuel cells.

UNIT–IV

Fuel Cell Reaction Kinetics: Introduction to electrode kinetics, activation energy of charge transfer reactions, activation energy determines reaction rate, net rate of a reaction calculation, rate of reaction at equilibrium: exchange current density, potential of a reaction at equilibrium: Galvani potential, potential and rate: Butler–Volmer equation, exchange currents and electrocatalysis: Improving kinetic performance, simplified activation kinetics: Tafel equation.

UNIT–V

Fuel Cell Charge Transport: Charges move in response to forces, charge transport results in a voltage loss, characteristics of fuel cell charge transport resistance, physical meaning of conductivity, review of fuel cell electrolyte classes. Fuel Cell Mass Transport: Transport in electrode versus flow structure, transport in electrode: diffusive transport, transport in flow Structures: convective transport. Overview of Fuel Cell Types: introduction, phosphoric acid fuel cell, polymer electrolyte membrane fuel cell, alkaline fuel cell, molten carbonate fuel cell, solid oxide fuel cell, other fuel cells.

TEXTBOOK:

1. O'Hayre, Ryan/ Colella, Whitney/ Cha, Suk-Won, Fuel Cell Fundamentals (3rd Ed.) by Wiley Publications. 2016 (B) Reference Books
2. James Larminie and Andrew Dicks, Fuel Cell Systems Explained, 2ndEd., John Wiley & Sons Inc. 2000
3. Supramaniam Srinivasan, Fuel Cells: From Fundamentals to Applications, Springer. 2010
4. Frano Barbir, PEM Fuel Cells Theory and Practice, Elsevier Academic Press. 2005

INDUSTRIAL ENGINEERING MANAGEMENT

Course Title: INDUSTRIAL ENGINEERING MANAGEMENT	
Teaching Scheme(L:T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	**Course Code: R24MEOE08**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Basic knowledge of management principles, industrial engineering, manufacturing processes, workshop practice, human factors, basic mathematics, production planning, and elementary costing is required to understand this course.	

Course Objectives:

1. To understand the concept of management and organizational structure.
2. To gain knowledge on work-study and allowances in work management.
3. To understand workplace designs.
4. To acquire knowledge of job evaluation and various wage schemes.
5. To estimate the cost of production in various manufacturing processes.

COURSE OUTCOMES	PO1	PO2	PO6	PS01	BT
Make managerial decisions for effective business administration.	1	2	2	1	L5
Explore various methods of work study and evaluate standard time.	2	3	1	2	L5
Design various types of workspaces.	2	2	3	3	L6
Explain and implement various job evaluation methods.	1	2	2	1	L3
Evaluate the overall cost of production for a product.	2	3	1	2	L5

SYLLABUS

UNIT–I

Introduction to Management concept & Organizational Structures:

Concept of Management and organization - functions of management - Taylor's scientific management, Fayol's principles of management, Douglas Mc-Gregor's Theory X and Theory Y, Maslow's Hierarchy of Human Needs – Mintzberg's Managerial Roles Approach – Mc.Kensey's 7'S Framework Organizational Structure – Departmentation – Line and Staff Structure – Span of Management – Matrix Structure, Boundaryless Organization, Virtual Organization**.**

UNIT–II

WORK STUDY: Introduction – definition – objectives – steps in work study Method study – definition – objectives, steps of method study, Outline process charts and Flow process charts. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

UNIT –III

WORK PLACE DESIGN: Anthropometry. Structural body dimensions, use of anthropometry data, work space dimensions – work space for personal when seated – minimum requirement for restricted spaces work surfaces, work surfaces when seated, standing science of seating, principles of seat design. Nature of Man – Machine system – Fundamental man – Machine system assumptions – types of Systems – Data base if human factors – Human performance – types of human error in system tasks – task data – empirical task data – Judgmental task data.

UNIT–IV

Visual displays – Process of seeing – types of visual activity – conditions that affect visual discriminations – Quantitative visual display – Basic design of dynamic quantitative displays, Quantitative visual display – Strategy indicators – signal and warning lights.

Job design – job evaluation – methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

Merit rating – job evaluation Vs merit rating – objectives of merit rating – method for merit rating – ranking method – paid company method – checklist method.

Wage incentive scheme – wages – objectives of a good wage incentive plan – basis of good wage – incentive plan – plan- types of wage – incentive plans – time method – straight piece rate method – differential piece rate method – Hasley premium plan – Emerson efficiency plan – Bedeaux point plan.

UNIT–V

ESTIMATING AND COSTING, ESTIMATION: Importance – Aims – functions – Qualities of estimator, Cost – definition Aims standard cost – difference between estimating and costing – costing methods – elements of costs – mensuration. Estimating of material cost & Overheads – machine shop – sheet metal shop – forging – welding Shop-Selling Price calculations.

REFERENCES:

1. Motion and time Study / Ralph M Barnes/ John Willey & Sons.
2. Works Study / Ilo
3. Human factors in Engineering & Design / Ernest J Mc Cormick/TMH
4. Production Operation management / Paneer Selvam/PH1
5. Industrial Engineering Management / Ravi Shankar/Galgotia
6. Mechanical Estimating Costing / T. T Banga & S.C Sharma/Khanna Publishers
7. Industrial Engineering Hand Book/ Maynard.

PRINCIPLES OF 3D PRINTING TECHNOLOGY

Course Title: PRINCIPLES OF 3D PRINTING TECHNOLOGY	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEOE09**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Students should have basic knowledge of Engineering Drawing, Manufacturing Processes, CAD, Materials Science, and computer fundamentals to understand the concepts of 3D printing and additive manufacturing technologies effectively.	

Course Objectives:

The objective of this course is to impart students to the fundamentals of various 3D Printing Techniques for application to various industrial needs. Student will be able to convert part file into STL format and will understand the method of manufacturing of liquid based, powder based and solid based techniques.

COURSEOUTCOMES	PO1	PO2	PO3	PS01	BT
Use software tools for 3D printing	3	2	2	3	L3
Prepare 3D printed modules	3	2	3	3	L3
Construct products using LOM technologies	3	2	3	3	L6
Construct products using FDM technologies	3	2	3	3	L6
Demonstrate understanding of Fused Deposition Modeling (FDM), including its process, applications, case studies, and practical implementation in additive manufacturing.	2	2	2	2	L2

SYLLABUS

UNIT–I

Introduction to Design, Prototyping fundamentals. Introduction to 3D printing, its historical development, advantages. Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of 3D printing process, Applications to various fields.

UNIT–II

Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies.

UNIT –III

Solid ground curing (SGC): Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies

UNIT–IV

Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.

UNIT–V

Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration

TEXTBOOK:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010

REFERENCES:

1. D.T. Pham and S.S. Dimov, “Rapid Manufacturing”, Springer, 2001
2. Terry Wohlers, “ Wholers Report 2000”, Wohlers Associates, 2000
3. Paul F. Jacobs, “ Rapid Prototyping and Manufacturing”–, ASME Press, 1996
4. Ian Gibson, Davin Rosen, Brent Stucker “Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

NON-CONVENTIONAL ENERGY RESOURCES

Course Title: NON-CONVENTIONAL ENERGY RESOURCES	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEOE10**
Continuous Internal Evaluation: 30Marks	**SemesterEndExam:70Marks**
Pre requisites: Students should have basic knowledge of Engineering Physics, Thermodynamics, Heat Transfer, Electrical and Mechanical Engineering fundamentals, and Environmental Studies to understand renewable energy systems, energy-efficient technologies, and sustainable engineering practices effectively.	

Course Objectives:

The students will acquire the knowledge:

1. To demonstrate the importance and solar radiation, solar energy collection and storage
2. To illustrate the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy
3. To interpret energy efficient electrical and mechanical systems
4. To develop energy efficient processes
5. To analyze features and benefits of green buildings

COURSEOUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT**
Demonstrate the importance and solar radiation, solar energy collection and storage	3	2	2	1	L2
Illustrate the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy	3	2	2	1	L2
Interpret energy efficient electrical and mechanical systems	3	3	2	3	L4
Develop energy efficient processes	3	3	3	3	L6
Analyze features and benefits of green buildings	2	3	2	2	L4

SYLLABUS

UNIT–I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT–II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy**.**

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques

UNIT –III

. **ENERGY EFFICIENT SYSTEMS:**

(A) ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management**.**

(B) MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps.

UNIT–IV

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing**.**

UNIT–V

GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management**.**

Text Books:

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013

References:

1. Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth & John F Kreider / Taylor &Francis
3. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
4. Renewable Energy Technologies -Ramesh & Kumar /Narosa
5. Non conventional Energy Source- G.D Roy/Standard Publishers
6. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd
7. Fuel Cell Technology -Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd

AUTOMATION IN MANUFACTURING

Course Title: AUTOMATION IN MANUFACTURING	
Teaching Scheme(L:T:P): 3:0:0	**Credits: 3**
Type of Course: LECTURE	**Course Code: R24MEOE11**
Continuous Internal Evaluation: 30Marks	**Semester End Exam: 70Marks**
Pre requisites: Students should have basic knowledge of Manufacturing Processes, Machine Tools, Fluid Mechanics, Hydraulics and Pneumatics, Industrial Engineering, and Fundamentals of Control Systems to understand automation, material handling, adaptive control, and automated manufacturing systems effectively.	

Course Objectives:

1. To analyze the types and strategies and various components in Automated Systems.
2. To classify the types of automated flow lines and analyze automated flow lines.
3. To solve the line balancing problems in the various flow line systems with and without buffer storage.
4. To interpret different automated material handling systems, storage and retrieval systems and automated inspection systems.
5. To illustrate the principles of Adaptive Control systems and recognize the types of automated inspection techniques and their applications.

COURSE OUTCOMES	PO1	PO2	PO3	PS01	BT
Analyze the types and strategies and various components in Automated Systems	3	3	2	3	L4
Classify the types of automated flow lines and analyze automated flow lines	3	3	3	3	L4
Solve the line balancing problems in the various flow line systems with and without buffer storage	3	3	3	3	L3
Interpret different automated material handling systems, storage and retrieval systems and automated inspection systems	3	2	2	3	L2
Illustrate the principles of Adaptive Control systems and recognize the types of automated inspection techniques and their applications	3	2	2	3	L2

SYLLABUS

UNIT–I

INTRODUCTION: Types and strategies of automation, pneumatic and hydraulic components, circuits, automation in machine tools, mechanical feeding and tool changing and machine tool control.

UNIT–II

AUTOMATED FLOW LINES: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT –III

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT–IV

AUTOMATED MATERIAL HANDLING and STORAGE SYSTEMS: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT–V

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems. AUTOMATED INSPECTION: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision

TEXTBOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover./ PE/PHI.

REFERENCES:

1. Computer Control of Manufacturing Systems by YoramCoren.
2. CAD / CAM/ CIM by Radhakrishnan.
3. Automation by W. Buekins

OPERATIONS RESEARCH

Course Title: OPERATIONS RESEARCH	
Teaching Scheme(L:T:P): 3:0:0	Credits: 3
Type of Course: LECTURE	Course Code: R24MEOE12
Continuous Internal Evaluation: 30Marks	Semester End Exam: 70Marks
Pre requisites: Students should have basic knowledge of Engineering Mathematics (especially Linear Algebra and Calculus), Probability and Statistics, Fundamentals of Optimization Techniques, and basic Computer Programming concepts to effectively understand Operations Research models, optimization methods, queuing theory, inventory systems, dynamic programming, and simulation techniques.	

Course Objectives:
1. To Analyze Linear Programming models
2. To Interpret Transportation and sequencing problems
3. To Solve replacement problems and analyze queuing models
4. To Analyze game theory and inventory problems
5. To Interpret dynamic programming and simulation.

COURSE OUTCOMES	PO1	PO2	PO3	PS01	BT LEVEL
Analyze Linear Programming models	3	3	2	3	L4
Interpret Transportation and sequencing problems	3	3	2	2	L2
Solve replacement problems and analyze queuing models	3	3	3	3	L3,L4
. Analyze game theory and inventory problems	3	3	2	2	L4
. Interpret dynamic programming and simulation.	3	3	2	3	L2

SYLLABUS

UNIT–I

DEVELOPMENT – definition– characteristics and phases – types of operation research models – applications.
ALLOCATION: Linear programming problem formulation – graphical solution – simplex method artificial variables techniques -two–phase method, big-M method – duality principle.

UNIT–II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem travelling salesman problem.
SEQUENCING – Introduction – flow –shop sequencing – n jobs through two machines – n jobs through three machines – job shop sequencing – two jobs through 'm' machines.

UNIT –III

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.
THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

UNIT–IV

WAITING LINES: Introduction – single channel – poison arrivals – exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.
INVENTORY: Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

UNIT–V

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.
SIMULATION: Definition – types of simulation models – phases of simulation– applications of simulation – inventory and queuing problems – advantages and disadvantages – simulation languages.

TEXTBOOK:

1. Operations Research-An Introduction/Hamdy A Taha/Pearson publishers
2. Operations Research –Theory & publications / S.D.Sharma-Kedarnath/McMillan publishers India Ltd

REFERENCES:

1. Introduction to O.R/Hiller & Libermann/TMH
2. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi /Pearson Education.
3. Operations Research: Methods & Problems / Maurice Saseini, Arhur Yaspan & Lawrence
4. Friedman/Wiley
5. Operations Research / R.Pannerselvam/ PHI Publications.
6. Operations Research / Wagner/ PHI Publications.
7. Operation Research /J.K.Sharma/MacMilan Publ.
8. Operations Research/ Pai/ Oxford Publications
9. Operations Research/S Kalavathy / Vikas Publishers
10. Operations Research / DS Cheema/University Science Press 10. Operations Research / Ravindran,
11. Philips, Solberg / Wiley publishers

SUSTAINABLE ENERGY TECHNOLOGIES

Course Title: SUSTAINABLE ENERGY TECHNOLOGIES	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEOE13**
Continuous Internal Evaluation: 30Marks	**SemesterEndExam:70Marks**
Pre requisites: Students should have basic knowledge of Engineering Physics, Thermodynamics, Heat Transfer, Fluid Mechanics, Electrical and Mechanical Engineering fundamentals, Environmental Science, and basic concepts of Energy Conversion systems to understand renewable energy sources, energy-efficient systems, and green manufacturing technologies effectively.	

Course Objectives:

The students will acquire the knowledge:
1. To demonstrate the importance of solar energy collection and storage.
2. To understand the principles of wind energy and biomass energy.
3. To gain knowledge on geothermal and ocean energy.
4. To acquire knowledge about energy efficient systems.
5. To understand the concepts of green manufacturing systems.

COURSEOUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT LEVEL**
Explain the importance of solar energy collection and storage.	3	2	2	1	L2
Apply the principles of wind energy and biomass energy.	3	3	3	2	L3
Analyze knowledge on geothermal and ocean energy.	3	3	2	2	L4
Justify the knowledge about energy efficient systems.	3	3	2	2	L5
Discuss the concepts of green manufacturing systems.	2	3	2	2	L2

SYLLABUS

UNIT–I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion types of PV cells.
SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.
SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT–II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.
BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters,
gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

UNIT –III

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy.
OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.

UNIT–IV

ENERGY EFFICIENT SYSTEMS:
(A) ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaries, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.
(B) MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps.

UNIT–V

GREEN MANUFACTURING SYSTEMS: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

TEXT BOOKS:

1) Solar Energy Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH.
2) Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006.
3) Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013.

REFERENCES:

1) Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New Age International.
2) Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth & John F Kreider /Taylor & Francis.
3) Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd.
4) Renewable Energy Technologies -Ramesh & Kumar /Narosa.
5) Non-conventional Energy Source- G.D Roy/Standard Publishers.
6) Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd.
7) Fuel Cell Technology -Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd.

ENERGY CONSERVATION MANAGEMENT

Course Title: ENERGY CONSERVATION MANAGEMENT	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEOE14**
Continuous Internal Evaluation: 30Marks	**SemesterEndExam:70Marks**
Pre requisites: Students should have basic knowledge of Engineering Mathematics (especially basic calculations and numerical methods), Electrical Engineering fundamentals, Thermodynamics and Heat Transfer, basic Physics of light and energy, and introductory concepts of Economics and Cost Analysis to effectively understand energy audit, lighting systems, power factor correction, HVAC systems, and financial analysis of energy management systems.	

Course Objectives:

The students will acquire the knowledge:
1. To illustrate energy efficiency, scope, conservation and technologies.
2.To design energy efficient lighting systems.
3.To analyze power factor of systems and propose suitable compensation techniques.
4.To interpret energy conservation in HVAC systems.
5.To analyze life cycle costing analysis and return on investment on energy efficient technologies

COURSEOUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT**
Illustrate energy efficiency, scope, conservation and technologies.	3	2	2	1	L2
Design energy efficient lighting systems.	3	3	3	3	L6
Analyze power factor of systems and propose suitable compensation techniques.	3	3	2	2	L4
Interpret energy conservation in HVAC systems.	3	2	2	1	L2
Analyze life cycle costing analysis and return on investment on energy efficient	3	3	2	2	L4

SYLLABUS

UNIT–I

Basic Principles of Energy Audit and management Energy audit Definitions Concept Types of audit Energy index Cost index Pie charts Sankey diagrams Load profiles Energy conservation schemes and energy saving potential Numerical problems Principles of energy management Initiating, planning, controlling, promoting,monitoring, reporting Energy manager Qualities and functions Language Questionnaire Check list for top management.

UNIT–II

Lighting Modification of existing systems Replacement of existing systems Priorities: Definition of terms and units Luminous efficiency Polar curve Calculation of illumination level Illumination of inclined surface to beam Luminance or brightness Types of lamps Types of lighting Electric lighting fittings (luminaries) Flood lighting White light LED and conducting Polymers Energy conservation measures**.**

UNIT –III

Power Factor and energy instruments Power factor Methods of improvement Location of capacitors Power factor with non linear loads Effect of harmonics on Power factor Numerical problems. Energy Instruments Watt hour meter Data loggers Thermocouples Pyrometers Lux meters Tong testers Power analyzer.

UNIT–IV

Space Heating and Ventilation Air Conditioning (HVAC) and Water Heating Introduction Heating of buildings Transfer of Heat Space heating methods Ventilation and air conditioning Insulation Cooling load Electric water heating systems Energy conservation methods.

UNIT–V

Economic Aspects and Financial Analysis Understanding energy cost Economics Analysis Depreciation Methods Time value of money Rate of return Present worth method Replacement analysis Life cycle costing analysis Energy efficient motors (basic concepts) Economics of energy efficient motors and system Computation of Economic Aspects Need of investment, appraisal and criteria Calculation of simple payback period Return on investment Net present value Internal rate of return numerical examples Power factor correction Lighting Applications of life cycle costing analysis Return on investment Numerical examples

TEXT BOOKS:

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd 2nd edition, 1995

REFERENCE BOOKS:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
3. Graw Hill Book company 1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wiley and sons.
5. Energy management and conservation k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.
6. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill

TOTAL QUALITY MANAGEMENT

Course Title: TOTAL QUALITY MANAGEMENT	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEOE15**
Continuous Internal Evaluation: 30Marks	**SemesterEndExam:70Marks**
Pre requisites: Students should have basic knowledge of Management Principles, Industrial Engineering fundamentals, Statistics and Probability, Production and Operations Management concepts, and basic understanding of Organizational Behavior to effectively learn Total Quality Management, statistical quality control, customer satisfaction, ISO standards, and quality cost analysis.	

Course Objectives:

The students will acquire the knowledge:

1. To analyze the concepts of TQM, Quality and Business performance
2. To illustrate importance of customer satisfaction and loyalty
3. To analyze Organizing for quality implementation
4. To interpret the concept of cost of quality
5. To analyze ISO 9000 universal standards of quality

COURSEOUTCOMES	**PO1**	**PO2**	**PO3**	**PS01**	**BT LEVEL**
Analyze the concepts of TQM, Quality and Business performance	2	3	2	2	L4
Illustrate importance of customer satisfaction and loyalty	1	2	2	1	L2
Analyze Organizing for quality implementation	2	3	3	3	L4
Interpret the concept of cost of quality	1	2	2	1	L2
Analyze ISO 9000 universal standards of quality	2	3	2	2	L4

SYLLABUS

UNIT–I

INTRODUCTION: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT–II

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

UNIT –III

ORGANIZING FOR TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT–IV

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management..

UNIT–V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-Series Standards, benefits of ISO9000 certification, the third-party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

TEXT BOOKS:

1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited
2. Total Quality Management/P.N.Mukherjee/PHI

REFERENCES:

1. 1 Beyond TQM / Robert L.Flood
2. 2 Statistical Quality Control / E.L. Grant / McGraw Hill.
3. 3 Total Quality Management- A Practical Approach/H. Lal
4. 4 Quality Management/KanishkaBedi/Oxford University Press/2011
5. 5 Total Engineering Quality Management/Sunil Sharma/Macmillan

NANO MATERIALS

Course Title: NANO MATERIALS	
Teaching Scheme(L:T:P):3:0:0	**Credits:3**
Type of Course: LECTURE	**Course Code:R24MEOE16**
Continuous Internal Evaluation: 30Marks	**SemesterEndExam:70Marks**
Pre requisites: Students should have basic knowledge of Engineering Physics, Chemistry, Solid State Physics, Materials Science, and basic Mathematics (especially calculus and linear algebra), along with introductory understanding of thermodynamics and quantum concepts to effectively learn nano materials, their structure, properties, synthesis, characterization techniques, and applications.	

Course Objectives:

The students will acquire the knowledge:
1. To analyze historical development and classification of nano materials
2. To interpret structure and bonding in nano materials
3. To analyze the size dependence of properties
4. To illustrate nano material Synthesis techniques
5. To interpret nano material characterization techniques

COURSEOUTCOMES	PO1	PO2	PO3	PS01	BT LEVEL
Analyze historical development and classification of nano materials	3	3	2	2	L4
Interpret structure and bonding in nano materials	3	2	2	1	L2
Analyze the size dependence of properties	3	3	2	2	L4
Illustrate nano material Synthesis techniques	3	2	3	2	L2
Interpret nano material characterization techniques	3	2	3	2	L2

SYLLABUS

UNIT–I

Introduction: Definitions, historical development of nano materials, classification of nano materials, Size & Scale Units Scaling Atoms, Molecules, Clusters and Supramolecules.

UNIT–II

Structure and Bonding in Nano materials

Chemical Bonds (types and strength), intermolecular forces, molecular and crystalline structures, hierarchical structures, bulk to surface transition, surface reconstruction

UNIT –III

. **Properties and Size dependence of properties**: Chemical Optical, vibrational, thermal, Electrical, Magnetic, Mechanical, Theoretical Aspects-e.g. density functional theory

UNIT–IV

Nano material Synthesis: Chemical routes, Electrochemical methods, Vapour growth, Thin films methods: chemical vapour deposition, physical vapor deposition (sputtering, laser ablation), Langmuir-Blodgett growth Mechanical methods: ball milling, mechanical attrition Sol-gel methods, Special nanomaterials: carbon nanotubes, fullerenes, nanowires, porous silicon, Bio-inspired synthesis, Nanocomposite fabrication, Nanolithography

UNIT–V

Nano material characterization techniques: Scanning and Transmission Electron Microscopy, Scanning Probe Microscopies: Atomic Force, scanning tunneling microscopy, Diffraction and scattering techniques, Vibrational spectroscopy, Surface techniques

Applications: Nano-electronics, Nano optics, Nanoscale chemical- and bio-sensing, Biological/bio-medical applications, Photovoltaic, fuel cells, batteries and energy-related applications, High strength nanocomposites, Nano energetic materials

Textbook

1.The Physics and Chemistry of Nanosolids by Frank J. Owens and Charles P. Poole Jr, Wiley-Interscience, 2008.

Reference Books

1.Nanomaterials- Synthesis, Properties and Applications, Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, London, 1998 (paper back edition)

2.Nanochemistry: A Chemical Approach to Nanomaterials, by G. Ozin and A. Arsenault, RSC Publishing, 2005

3.Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH, 2nd Reprint (2005)